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BRITISH MEDICAL BULLETIN

Part I: Public Health Laboratory Service

PUBLIC HEALTH LABORATORY SERVICE
LABORATORY CONTROL OF THE ENTERIC FEVERS
SALMONELLA REFERENCE LABORATORY
FOOD-POISONING AND FOOD HYGIENE
STUDY OF AIR-BORNE INFECTIONS
DIAGNOSIS OF VIRUS DISEASES
STANDARDIZATION OF SEROLOGICAL REAGENTS
FIELD TRIALS OF PROPHYLACTIC AGENTS
EPIDEMIOLOGICAL CONTROL OF INFECTIOUS DISEASES
NATIONAL COLLECTION OF TYPE CULTURES
SANITARY BACTERIOLOGY
FUNGUS DISEASES IN BRITAIN
DYSENTERY REFERENCE LABORATORY
SEROLOGICAL CONTROL OF VENEREAL DISEASES
WORK OF AN AREA LABORATORY

Part II: Commentary · History · Documentation

ENGLISH PUBLIC HEALTH SINCE 1834
NEW TRENDS IN SOCIAL MEDICINE
MANSON'S TROPICAL DISEASES

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ANNOTATIONS & NEWS

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BOOK REVIEWS **FILM REVIEWS**

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Public Health Laboratory Service

We have thought it useful to devote the symposium in this number to a survey of the work and organization of the Public Health Laboratory Service in England and Wales.

This Service, which is not exactly paralleled in any other country, grew out of the emergency of war. It now embraces one Central Laboratory with its dependent Reference and Standards laboratories, five Regional laboratories and, at present, forty-nine area and associated laboratories.

The history and organization of the Service are admirably described by Dr G. S. Wilson in the opening article. If this is read first, a clear and vivid picture is obtained of the scope and usefulness of the Service. The articles which follow explain in detail the work of the various individual laboratories. They also bring out very clearly the advantages of a centralized service. More than once, what first appeared to be sporadic cases of a disease were, by reference and identification at the centre, shown all to arise from one source. The immense value of such a service in the control of epidemic disease needs no emphasizing.

It is interesting to recall two events that took place only some eighty years ago. Bacteriology, as a science, began to take shape, and one by one the causal organisms of many diseases were identified. About the same time, in 1870, the British Parliament approved the first grant to the Privy Council for " auxiliary scientific investigations "—a sum of £2,000 per annum. From the conjunction of these two events, it might be said, eventually arose the Public Health Laboratory Service described in the pages that follow.

We wish to express to Dr G. S. Wilson, Director of the Public Health Laboratory Service, our thanks for his unsparing help and advice in the preparation of this number.

FIG. 1. LOCATION OF THE LABORATORIES OF THE PUBLIC HEALTH LABORATORY SERVICE

THE PUBLIC HEALTH LABORATORY SERVICE

G. S. WILSON M.D. F.R.C.P. D.P.H.

Director, Public Health Laboratory Service
Medical Research Council, London

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A survey of public health laboratory facilities in England and Wales made two or three years before the Second World War revealed a disconcerting irregularity in their distribution. Some parts of the country were reasonably well served by a mixture of university, hospital and municipal laboratories ; others had no local services, and had to rely on commercial laboratories situated in distant towns for the satisfaction of their exiguous demands. The service rendered by even the best laboratories was mainly of the so-called postal type, in which, in return for a fee, the laboratory furnished a report on any specimen submitted to it. Consultation with the doctor or sanitary inspector taking the specimen was unusual, and participation in field inquiries was quite exceptional. In conditions such as these the amount of work done was determined largely by the ability to pay for it. When investigating an outbreak of infectious disease, the medical officer of health had his enthusiasm curbed by the constant reminder that every additional swab he took added to the bill which he would have to present to his local council. Only if he was attached to one of the wealthier counties or county boroughs could he look for serious help from the laboratory. In consequence, most small outbreaks were neglected ; larger outbreaks were investigated perfunctorily ; and not unless an outbreak was extensive or had particular social repercussions was the Ministry of Health's laboratory in London called in to assist. There was, moreover, under this system no means of pooling the results from individual laboratories so as to obtain a more or less comprehensive picture of the distribution of infection throughout the country. Each laboratory worked as an isolated unit, and seldom corresponded with other laboratories. A great deal of potentially useful information was therefore wasted.

Taking a wide view of the defence potential of the country in face of attempted bacterial sabotage or warfare, the Committee of Imperial Defence saw that such an irregularly scattered miscellaneous collection of laboratories was not fitted to provide a satisfactory service for the rapid and exact diagnosis of infectious disease, nor to act as a network for the collection of epidemiological information. It was exercised, too, over the difficulty of providing, in the existing conditions, for the control of widespread epidemic disease that might occur as the result of disordered evacuation from the big industrial centres under the threat of intense aerial bombardment. It therefore decided to establish a special service to assist in the diagnosis, prevention, and control of infectious disease throughout England and Wales. In agreement with the Ministry of Health, the organization of the new service was entrusted to the Medical Research Council, whose long experience of dealing with technical problems was thought to render it more suitable for this role than the Ministry of Health whose functions are mainly advisory and administrative.

1. The Emergency Public Health Laboratory Service

The story of the Emergency Public Health Laboratory Service has already been briefly told for readers of this Bulletin in the article by Dr A. Landsborough Thomson (1943), on whose shoulders the burden of organizing and administering the new Service chiefly fell. To overcome the disadvantages of the current system, the Emergency Service was constituted on a national basis ; new laboratories were established where they were needed ; existing laboratories, when suitable, were associated with the Service ; the staff were instructed to be ready to co-operate in field inquiries ; examinations for the diagnosis and control of infectious disease were to be carried out free of charge ; arrangements were made for the transmission of information of epidemiological interest to central headquarters ; and by a system of specially strengthened regional laboratories the provision of extra help for other laboratories at times of unusual stress was allowed for.

Preparations were begun early in 1938. Premises in schools, technical colleges, and universities were designated as future laboratories ; scientific and technical staff were recruited from the bacteriological departments of medical schools, research institutes, and the Ministry of Health's laboratory in London ; apparatus was bought and stored at convenient centres ; and provision was made for transport at the different laboratories. When the call for mobilization came at the end of August 1939, the staff moved rapidly to their allotted posts, and within a week or so were ready to cope with any emergency that might arise.

It was some time before the new Service found its feet. The war took a course quite different from that which had been predicted, and the absence of widespread epidemics nullified one of the chief reasons for the creation of an Emergency Service. It was not long, however, before opportunities for usefulness arose. Outbreaks of diphtheria started to occur in village schools following on the admixture, which resulted from evacuation, of town and country children. Medical officers of health were too busily engaged in administrative duties to spare time for the proper investigation of these outbreaks, and many were only too ready to delegate this task to the new laboratories. Approaching field problems from a research angle, the bacteriologists soon worked out a method, based on swabbing and combined active and passive immunization, which proved remarkably successful in bringing institutional outbreaks of diphtheria under control without resorting to the usual practice of closure of the institutions. Trouble also arose from infectious disease in the numerous

residential and day nurseries that sprang up during the early years of the war, and here again the Emergency Service was able to help. Canteens and communal feeding centres presented special problems on which the bacteriologist could throw light. Cross-infections in the surgical wards of the hospitals and in the overcrowded nurseries of maternity homes called for expert bacteriological and epidemiological investigation. The military authorities needed advice on the purity of water supplies for newly established camps ; and the war-time regulations for the heat treatment of milk necessitated the careful laboratory control of pasteurization.

As a concomitant of these and similar activities, the Service gradually began to function as a team, co-ordinated epidemiologically from the centre. Neighbouring laboratories joined with each other in the investigation of outbreaks that had passed beyond their local boundaries, and mobile squads were organized for the control, by immunization and other measures, of epidemic disease that threatened to assume major proportions. One of the most beneficial results of the operation of the team spirit was the development of a system of reference experts and reference laboratories. Bacteriologists with a research background could not be content with merely recognizing the species of organisms concerned in the causation of disease ; they wanted an exact identification of the serological or bacteriophage types to which they belonged. Indeed, it became abundantly clear that, in the investigation of such diseases as scarlet fever, typhoid fever, pemphigus, and salmonella food-poisoning, little progress could be made in detecting the ultimate source or carrier without this knowledge. Since bacterial " typing " required not only skill and experience, but a set of special reagents that were difficult to prepare and were hence in short supply, it followed that this work tended to become concentrated in certain laboratories where these requirements could be met. The reference laboratories proved remarkably successful. Not only were they appealed to for help in bacteriological problems by workers throughout the country, but they came to play an unexpectedly important part in the epidemiological activities of the Service. Receiving cultures, as they did, from many different areas, they were often able to draw attention to a relationship between cases of disease in separate localities caused by the same type of organism, and so define a problem the existence of which was unsuspected by any of the individual laboratories submitting the cultures.

By 1944, when plans for the new National Health Service were under consideration, the Emergency Service had established itself so firmly in the public health organization of the country that it was decided to make provision for its continuance in the permanent post-war structure. By constant research and by adoption of the best technical methods available, it had set a high standard of practice ; and by virtue of its special constitution it had developed a technique of acquiring epidemiological information that was unobtainable in any other way. A suitable clause was included in the National Health Service Bill. This passed through Parliament in November 1946, and the Public Health Laboratory Service dropped its emergency title and looked forward to a process of consolidation and expansion in the years ahead.

2. General Organization of Pathological Services

Before concentrating on the Public Health Laboratory Service itself, it may be well to put it in its proper setting by describing briefly the organization of other pathological services in England and Wales.

Under the National Health Service Act, provision is made for two types of pathological work—hospital pathology and public health bacteriology. Hospital pathology is concerned primarily with the diagnosis and treatment of the individual patient ; it comprises morbid anatomy and histology, haematology, biochemistry, and clinical bacteriology. Public health bacteriology, on the other hand, is concerned with the diagnosis, prevention, and control of infectious disease in the community as a whole ; it comprises bacteriological work not only in the laboratory but also applied to field conditions and epidemiology. Hospital pathology is organized on a regional basis and is under the immediate control of the Regional Hospital Boards. Public health bacteriology is organized on a national basis and is under the immediate control of the Medical Research Council. Both branches are under the ultimate control of the Ministry of Health. Medico-legal work is mostly carried out by the hospital pathologists ; but for difficult cases, including those requiring police action, the Home Office maintains a small staff of specially qualified pathologists, and makes use of the part-time services of a few hospital pathologists who have had long experience of this type of work.

Pathological laboratories for the diagnosis and control of disease in domestic animals are provided by the National Veterinary Service, which is under the control of the Ministry of Agriculture and Fisheries. There is one large central veterinary laboratory at Weybridge in Surrey, and a number of divisional laboratories. The veterinary pathological service is still far from being fully developed and, in the meantime, some of the veterinary work is carried out by the Public Health Laboratory Service, which maintains close relations with its veterinary colleagues, particularly in epidemiology and research.

The hygienic control of milk produced on the farm is carried out by the National Milk Testing Service, which, like the National Veterinary Service, operates under the Ministry of Agriculture and Fisheries. These laboratories, however, concern themselves only with the cleanliness of milk, not with its safety. Examinations for pathogenic organisms, such as the tubercle bacillus and *Brucella abortus*, are made by the veterinary or the public health laboratories.

The chemical analysis of water, milk, and foods is mainly a function of the public analysts. These do not form part of any national service. They are appointed locally by food and drugs authorities. Some of them are whole-time workers employed by the authority ; others are in private practice and charge on a fee-per-specimen basis.

3. Organization of the Public Health Laboratory Service

The Public Health Laboratory Service is administered by the Medical Research Council on behalf of the Ministry of Health. The Council has delegated its main duties in this respect to a Board—the Public Health Laboratory Service Board—which is responsible for the general conduct of the Service, the appointment and payment of staff, the provision of buildings, and the supply of equipment. The day-to-day executive work is carried out by the administrative officers of the Council, and is rendered all the more easy by the fact that the Second Secretary of the Council is also Chairman of the Board.

PUBLIC HEALTH LABORATORY SERVICE *G. S. Wilson*

Headquarters

The Director of the Service has his headquarters in London. His main duties are to advise the Board on the location and building of laboratories, on the selection of staff, on relations with outside bodies, and on matters of general policy. In addition, he is responsible to the Board for the efficient running of the Service ; for maintaining close liaison with the various Ministries, with the Hospital Pathology Service, and with the National Veterinary Service ; and for editing the public health laboratory section of the *Monthly Bulletin*. His office acts, moreover, as the epidemiological headquarters of the Service. Here the weekly reports from the different laboratories are received, a " weekly summary " of the distribution of infectious diseases is prepared, and arrangements are made—usually in conjunction with the Ministry of Health —for epidemiological investigations to be undertaken into outbreaks of disease of special importance or extent. Finally, the Director plays an important role in initiating and guiding the general lines of research within the Service, in organizing group inquiries, and in suggesting or co-operating in joint investigations with other branches of the Medical Research Council. In order that research may be properly fostered the Director has to assure himself that the necessary facilities are provided and that the laboratories are sufficiently well staffed to allow of time for investigation apart from that devoted to routine work.

Central Public Health Laboratory

The Central Public Health Laboratory is situated at Colindale in north-west London in premises that were originally designed for the Government Lymph Laboratory. It contains (a) a routine laboratory serving the adjacent area of Middlesex; (b) four reference laboratories—the Central Enteric Reference Laboratory and Bureau, the Salmonella Reference Laboratory, the Streptococcus and Staphylococcus Reference Laboratory, and the Virus Reference Laboratory ; (c) the Food Hygiene Laboratory, which is concerned mainly in problems of food hygiene but acts to some extent as a reference laboratory for food-poisoning ; (d) the Standards Laboratory for Serological Reagents, which used to be known colloquially as the Oxford Standards Laboratory, and which prepares suspensions and antisera used for the diagnosis of infectious disease ; (e) the National Collection of Type Cultures, housed for many years at the Lister Institute ; (f) an Epidemiological Unit engaged mainly in the supervision of field trials and, in conjunction with the headquarters office, in the collection and analysis of information gained by the Service on the distribution and origin of infectious disease.

Because of the increasing work of the reference laboratories and the requests for permission to study in them received from students in many parts of the world, the Central Laboratory is grossly overcrowded and cannot fulfil all its functions satisfactorily. Permission has been given for its extension, and work has now begun on the building of a new three-storey laboratory.

Regional Laboratories

There are five regional laboratories, situated in university towns—Oxford, Cambridge, Manchester, Newcastle, and Cardiff. Most of them are staffed by four or five medically qualified workers of some experience, and have in addition one or two junior bacteriologists in course of training. Each of the laboratories carries out routine bacteriological and epidemiological work for the surrounding neighbourhood, engages in research, and acts to some extent as a parent laboratory for a group of Area laboratories, which look to it for help in the provision of staff substitutes during periods of leave, for assistance in epidemiological inquiries that are beyond the local capacity, and for certain other purposes. Two of the laboratories, Cambridge and Cardiff, also take part in the teaching of students at the university, and in this way are brought into close touch with members of the university pathological department. It is hoped to raise Area laboratories in some other university towns to regional status when staff and buildings permit. (See fig. 1.)

Area Laboratories

The term " Area laboratory " is used for laboratories whose main function is to carry out the laboratory and field work for local authorities and other bodies within an area having a radius of about 25 miles. The extent of the area, however, varies considerably, being more or less inversely proportional to the density of the population. Many of the Area laboratories serve individual counties, though they are in no way limited by the county's administrative boundary. As the Service is not yet fully developed, there are still parts of the country without an Area laboratory. The present distribution is: *England*: Birkenhead, Birmingham, Bradford, Brighton, Coventry, Dorchester, Epsom, Exeter, Hereford, Hull, Ipswich, Leicester, Lincoln, London (Camberwell), London (Hither Green), Luton, Northallerton, Northampton, Norwich, Nottingham, Peterborough, Poole, Portsmouth, Reading, Sheffield, Shrewsbury, Southampton, Southend, Stafford, Sunderland, Taunton, Truro, Wakefield, Watford, Winchester, Worcester. *Wales* : Aberystwyth, Carmarthen, Conway, Newport. (See fig. 1.)

Though engaged primarily in routine work, most of the Area laboratories are also undertaking research, making use for this purpose of the extensive material that passes through their hands and collaborating with each other in group investigations.

Associated Laboratories

During the war the Emergency Service associated with itself suitable existing laboratories engaged in public health work. After the establishment of the permanent Service, some of these laboratories were taken over by the Medical Research Council as constituent laboratories, and it is hoped that eventually all of them will be included within the national service. At the present time, Associated laboratories are situated at Bristol, Carlisle, Derby, Leeds, Liverpool, Maidstone, Plymouth, Salisbury, and Swansea. These laboratories function very much in the same way as Area laboratories, though, owing mainly to shortage of staff, only a few of them are able to take part in field inquiries. The cost of the work they do on behalf of the Service is reimbursed by the Medical Research Council.

Recognized Laboratories

There are parts of the country in which specimens collected late in the day cannot be delivered to the nearest public health laboratory in time for examination the same evening. Use is therefore made of suitable hospital laboratories in the neighbourhood for carrying out examinations not only of the " medical " type of specimen, but also of the " sanitary " type, i.e., specimens of non-human or non-animal origin such

as water, milk, ice-cream, shell-fish, food and sewage. If the hospital laboratory is properly equipped for this work and has on its staff a bacteriologist with the necessary training, it is "recognized" by the Medical Research Council, which reimburses it for all expenditure on the sanitary type of work. So far, very few hospital laboratories have been recognized in this way ; and it is expected that when the Service is fully developed this particular mechanism should seldom be needed except for the examination of urgent medical specimens.

Reference Laboratories

Mention has already been made of the development of Reference laboratories in the Emergency Service and of the useful part they play in the epidemiological study of infectious disease. The methods employed for the exact identification of some groups of organisms have been adapted to other groups, with the consequent widening of the services rendered by these laboratories. For instance, the Vi-phage typing of typhoid bacilli proved so successful in field investigations that it was extended to the typing of paratyphoid B bacilli and of *Salm. typhi-murium*, as described by Dr Felix in his article in this number of *British Medical Bulletin*.[1] Again, the difficulty of investigating outbreaks of staphylococcal food-poisoning and of staphylococcal infection in maternity homes and operating theatres, on account of the high normal carrier rate, stimulated a demand for the identification of individual strains. Two approaches were made, one by the serological method of agglutination, the other by the bacteriophage method ; both of these were partly successful, so that, though staphylococcal typing still lags far behind that achieved for typhoid bacilli, it is nevertheless able now to help in tracing many outbreaks of infection to their source.

The four Reference Laboratories at Colindale—Enteric, Salmonella, Streptococcal and Staphylococcal, and Virus—are supplemented by the Venereal Diseases Reference Laboratory at St Peter's Hospital, London, the Mycological Reference Laboratory at the London School of Hygiene and Tropical Medicine, the Malaria Reference Laboratory at Horton, and the Dysentery Reference Laboratory at Oxford. This last laboratory will probably be moved to Colindale in the near future so that it may be near the Enteric and Salmonella Reference Laboratories, the Standards Laboratory, and the National Collection of Type Cultures, with all of which it needs to be in close touch.

The inclusion of the Venereal Diseases Reference Laboratory in the Public Health Laboratory Service is a little anomalous. Under the National Health Service Act responsibility for carrying out pathological examinations of venereal disease (VD) specimens rests with the hospital laboratories, mainly because examinations of this sort are carried out primarily for the diagnosis or treatment of the individual patient. Public health measures for the prevention of venereal disease and the protection of the community as a whole have not so far been developed to any considerable extent in Great Britain. When they are adopted, as they almost certainly will be, many of the serological examinations for the detection of venereal disease will be made primarily in the public health interest and may well be undertaken by the Public Health Laboratory Service. As it is now, not all hospital laboratories are able to cope with the demands made upon them, and a considerable amount of VD pathological work, both from antenatal and from VD clinics, is in fact undertaken by the public health laboratories. The VD Reference Laboratory fits very well into the system of reference laboratories maintained by the Service and, as described by Dr Orpwood Price in his article, fulfils a useful function in providing standard reagents for laboratories carrying out their own serological examinations, and in acting as a centre to which problem sera can be sent for special report.

It should be emphasized that the Reference laboratories, though intended in the first place for the benefit of the Public Health Laboratory Service itself, are open freely for use by any laboratory, whether hospital, university, or commercial, in England and Wales. Indeed, their sphere of service extends to Scotland, Northern Ireland, Eire, and, in some instances, to other countries as well ; for example, three of them—the Central Enteric, the Salmonella and the Dysentery—act as international reference laboratories under the World Health Organization. This is very welcome, because the more information they can obtain about the geographical distribution of different types of organisms, the more help can they give in the investigation of outbreaks of disease in any particular locality.

In addition to Reference laboratories, the Service retains a number of experts for the examination of occasional specimens that needs special skill or knowledge. By this means any laboratory in the Service can obtain help and advice on problems of bacteriology, entomology, protozoology, or helminthology, occurring in relation to its general work.

Selection and Training of Staff

The scientific staff is recruited almost entirely from newly qualified medical graduates after they have held house appointments for six or twelve months. Their training lasts for five years. The first year is spent in the pathological laboratory of a large teaching hospital, where they obtain a good general background of morbid anatomy and histology, haematology, and biochemistry. This is followed by a year in an Area laboratory learning the routine bacteriological methods employed in public health work. During the third year the trainee takes the Diploma in Bacteriology course at the Universities of London or Manchester ; this is a most valuable year, in which the fundamental basis of bacteriological and immunological procedures can be studied and in which the main lines of research development are appreciated. The fourth and fifth years are occupied at a Regional laboratory in further routine work, in research, in field inquiries, and sometimes in teaching. During the whole of this period the trainee is paid on an increasing scale, and all fees for courses and examinations are met by the Service. After the end of their third year trainees act as substitutes in Area laboratories for four or six weeks during the leave period and learn to take responsibility on their own shoulders. Any support they need they can get from the Regional laboratories. Very little use is made of non-medically qualified science graduates except in the Reference laboratories and in other laboratories handling a large number of sanitary specimens. In a Service with a strong epidemiological bias the science graduate without a knowledge of clinical or preventive medicine is at a serious disadvantage and has little hope of rising to the top.

The technical staff is recruited from boys and girls leaving school at 16 or 17 years of age who have reached a sufficient standard of education. Like the medical staff, they go through a five-year apprenticeship system of training, taking the appropriate examinations of the Institute of Medical Laboratory Technology after three and five years.

[1] See p. 153.

4. General Scope of the Public Health Laboratory Service

a. Routine Laboratory Work

This comprises the examination of "medical" specimens from general practitioners, infectious diseases hospitals, and local authorities. The "sanitary" specimens come chiefly from local authorities and food and drugs authorities. The work is essentially bacteriological. Except in areas where there is no hospital laboratory, clinical pathological specimens other than bacteriological are referred to the local pathologist. Sanitary specimens for chemical examination, apart from milks to be submitted to the phosphatase test, are not accepted; instructions are given that they should be sent to a public analyst. The hospital laboratories are responsible for the examination of VD specimens taken for diagnosis and treatment, and of specimens from tuberculous patients under treatment in hospitals and sanatoria; all other specimens of human origin taken from persons suspected of suffering from infectious disease fall within the scope of the Public Health Laboratory Service. As many of the public health laboratories are situated in hospital grounds or closely adjacent to them, there is a good deal of elasticity in the distribution of specimens between the hospital and public health laboratories, and in some places the public health laboratory actually undertakes the clinical bacteriology of the hospital on a delegated basis. All these examinations, and those of specimens of animal origin submitted by veterinarians, meat inspectors, and others, are carried out free of charge.

The sanitary work includes mainly the examination of specimens of water, milk, ice-cream, shell-fish, other foods, and sewage. Apart from sewage, the bacteriological control of all these materials falls into two divisions: control of the article during production, and control of the article as offered for human consumption. The general principle of the Service is to examine free of charge all articles in this second category—the "consumer" article. Responsibility for the quality of the article during the course of production rests, for water, with municipal, private, or public utility undertakings; for milk, with the Ministry of Agriculture and Fisheries; and for ice-cream, shell-fish and other foods, generally with commercial bodies. The Public Health Laboratory Service is ready to give advice freely to manufacturers and processers in order to enable them to produce the best possible product; this includes such research and control investigations carried out on processing plants as are necessary for sound bacteriological advice to be offered. The routine examination, however, of materials during the production or processing stage is undertaken by the Public Health Laboratory Service only on payment. It is felt that the control of the raw article is a function of the producer and is best carried out by the producer himself, or, with milk, by the special advisory and testing services set up for this purpose by the Ministry of Agriculture and Fisheries.

This is not the place to defend or justify the dichotomy of bacteriological control that exists over food materials in general. Objection can readily be taken to a system whereby milk produced on the farm is examined by the Ministry of Agriculture and the same milk, as delivered to the consumer, by the Public Health Laboratory Service. In practice, the objection is not serious, partly because information can be exchanged when necessary, and partly because the Ministry of Agriculture restricts itself to control of the bacterial cleanliness of the milk. If there is any suspicion of infectious disease being carried by the milk, the medical officer of health has the right to visit the farm and submit any specimens of human or animal origin, including the milk itself, to the public health laboratory for examination for pathogenic organisms.

No specimens of medical or sanitary type are accepted for examination from private persons; they must be collected by doctors, veterinarians, sanitary inspectors or other representatives of official bodies. Any private person who wishes for an independent examination of such substances as well-water or the remains of food that he has eaten must go to a commercial laboratory or a private pathologist and pay the necessary fee.

Altogether the number of routine specimens examined is at present about 1,200,000 a year, but it is rising steadily. This figure does not include the numerous additional specimens examined by the Reference, the Associated, and the Recognized laboratories.

b. Field Inquiries

The provision of a field service has been one of the most beneficial of the innovations introduced. Experience has shown that in the investigation of an outbreak of infectious disease far more satisfactory results can be obtained if the bacteriologist, working in close co-operation with the medical officer of health or medical superintendent, can visit the scene of the outbreak, can see for himself the conditions under which it has originated, and can collect his own specimens and make his own cultures on the spot. Bacteriology has become a highly specialized subject, and the thorough investigation of an outbreak generally requires far more than the collection of a few specimens, often poorly chosen and submitted to a distant laboratory for a perfunctory examination. Since the Public Health Laboratory Service has been in operation, it is probably true to say that at least ten times as many outbreaks of infectious disease are investigated as before the war, and that our knowledge of the distribution of infecting organisms, supplemented as it is by the exact identification carried out by the Reference laboratories, is very much fuller and more exact.

Field work includes not only the investigation of infectious disease, but help given in a wide variety of ways to local authorities, water-undertakings, food processers, and other bodies, with the general aim of preventing disease. The whole of the field work is done primarily with a research purpose in mind. The control of infectious disease, as distinct from its investigation, is a statutory function of the medical officer of health; and the Public Health Laboratory Service, apart from giving advice to the medical officer of health or acting on his behalf, does not attempt to control disease directly. On the other hand, the Service is very interested in research into different methods of control. Clearly, with the choice of various ways of segregating and isolating patients, convalescent carriers and healthy carriers, and of using vaccines, antisera, chemotherapeutic agents, and antibiotics, there is a wide field open for determining the most satisfactory and expeditious way of bringing to an end outbreaks of different infectious diseases occurring in different types and densities of population. Success has been achieved in the control of diphtheria, but the control of dysentery, scarlet fever, poliomyelitis, and a number of other diseases occurring in institutions or among the general public presents a challenge that calls for intensive research work by the laboratories.

c. Research Investigations

Research investigations are of various types. In nearly every laboratory research work of some kind is being conducted on the routine material submitted for examination. New methods of demonstrating the presence of organisms, new enrichment or selective culture media, and new techniques of various kinds are being tested ; the distribution of different types of organisms is studied ; and epidemiological information is accumulated.

In addition to these, however, more fundamental investigations are carried out in some laboratories by individual workers or by two or three workers in conjunction. Examples are the observations of Hoyle (1948) on the cycle of development of the influenza virus in the developing hen's egg, the study of tetrathionase by Knox, Gell & Pollock (1943) and Pollock & Knox (1943), the work of Fulton (1943) on staphylococcal enterotoxin, and of Moore (1948, 1950) on the development of a technique for isolating typhoid and paratyphoid bacilli from sewage.

Another type of investigation, however, that has proved very successful is the so-called " group research ". The idea was born in the early part of the war, when dried egg was first imported on a big scale. The problem was to find out what proportion of it was contaminated with organisms of the *Salmonella* group. To solve this, it was arranged for regular specimens to be sent to each of the Area laboratories. A suitable technique was soon worked out between them, and in a very short time several hundred specimens had been examined and the necessary information obtained.

Since then, numerous group investigations have been fostered. Members of the staff of different laboratories who are interested in particular subjects are brought together to form a small committee or working party. They discuss their method of approach and, after having agreed on a technique to be followed, make observations on material in their separate areas, bring their results together, analyze them, and prepare a report. In this way valuable information has been obtained on such problems as the treatment of diphtheria carriers, the synergic action of penicillin and sulphathiazole on chronic typhoid carriers, and the bacteriological grading of ice-cream. Sometimes workers outside the Service are brought in. The large survey carried out during the war into the proportion of non-pulmonary cases of tuberculosis caused by the bovine type of tubercle bacillus is an excellent example of what can be achieved by this method (*Journal of Hygiene*, 1949). Group research has the advantage of making use of ordinary routine material which, if examined by any one laboratory alone, would not afford sufficient justification for drawing generalized conclusions. Moreover, it may lead to quite different results in different parts of the country, and thus reveal some unrecognized variable in the technique or some difference in the distribution of a particular organism in different localities.

d. Field Trials

Many infectious diseases cannot be reproduced satisfactorily in laboratory animals and tests for protective agents against them cannot therefore be made satisfactorily except on the human subject. This was brought out very clearly in 1941, when a batch of alum-precipitated toxoid (APT) was found, as judged by the Schick-conversion rate, to confer a low degree of protection of children against diphtheria, even though it had passed the appropriate guinea-pig tests laid down under the Therapeutic Substances Act, 1925. Arrangements were made for special field trials with different batches of APT to be carried out on groups of children ; as a result, substantial changes were introduced into the method of standardizing the product by the guinea-pig method, and a much higher protective potency was demanded.

Field trials now in progress on whooping-cough vaccine, on gamma globulin for measles, and on a purified toxoid, aluminium-phosphate-precipitated (PTAP) are described by Dr Cockburn and Dr Harrington in the present series of articles. We do not believe the information provided can be obtained in any other way, and we are hoping with the aid of medical officers of health to establish an organization that will allow any prophylactic agent of promise to be submitted to rigidly controlled trials in the field.

e. Distribution of Biological Reagents

The Service performs a useful function in distributing special biological reagents that are required for immunization or for diagnosis. Among the former are vaccine lymph for protection against smallpox, alum-precipitated diphtheria toxoid, typhus vaccine, gamma globulin for the prevention or attenuation of measles, rabies vaccine, and anthrax antiserum for prophylactic use. The diagnostic reagents, like some of the immunizing reagents, comprise those that are difficult to obtain through ordinary commercial channels, such as brucellin, Trichina antigen, hydatid antigen, and the Frei antigen for the diagnosis of lymphogranuloma inguinale. The commoner of these reagents are stored in every laboratory whence they can be easily distributed to medical officers of health and general practitioners requiring them. Those reagents which are called for less often are stored at Colindale and the Regional laboratories or at Colindale alone. Biological reagents needed for therapeutic, as opposed to preventive, treatment are held by the hospitals.

5. Provision of Information

The confidential " Weekly Summary " of the distribution of infectious diseases during the previous week, based on reports from the Regional, Area, Associated, and Reference laboratories of the Service, and of the Recognized hospital laboratories, is sent out every Friday, and keeps laboratory workers informed of what is happening in other parts of the country.

The *Monthly Bulletin of the Emergency Public Health Laboratory Service* was first published in November 1941. The articles it contained were provided by members of the Service, and comprised partly epidemiological and partly laboratory studies. This *Bulletin* was issued to the public health laboratories, to medical officers of health, to principal regional medical officers, and to the medical heads of the three fighting services. From the start it received a warm welcome. In October 1943 its scope was widened to represent the Ministry of Health, which saw in it a means of conveying useful information from the central departments to medical officers in the field. The joint *Monthly Bulletin of the Ministry of Health and the Public Health Laboratory Service* is issued free of charge to any responsible medical officer, local authority, institute or library that asks for it. It goes to all parts of the world, and its circulation is now between 3,000 and 4,000 copies a month. Special technical bulletins are issued from time to time for the benefit of members of the Service.

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LABORATORY CONTROL OF THE ENTERIC FEVERS

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1 Typing by means of Vi bacteriophage
- *a* Typing of *Salm. typhi*
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- *c* Typing of *Salm. paratyphi A*
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- *e* Administrative problems in countries with low and high incidence of enteric fevers

References

The control of the enteric fevers depends ultimately on the control of the chronic carrier. Recent advances in laboratory methods have provided the epidemiologist and public health administrator with new weapons to detect the chronic carrier. The new developments in laboratory technique are:

i. The introduction of refined culture media for the isolation of typhoid and paratyphoid bacilli;
ii. The typing of typhoid and paratyphoid-B bacilli by means of Vi bacteriophage;
iii. The Vi-agglutination test as an aid to the detection of chronic typhoid and paratyphoid-B carriers.

The object of this paper is to review the development of the latter two techniques and their present status, and to describe the work of the Central Enteric Reference Laboratory and Bureau. The various selective media and enrichment procedures for the isolation of organisms of the enteric group need not be discussed here, since they are generally known and already used for routine purposes.

1. Typing by Means of Vi Bacteriophage

a. Typing of Salm. typhi

Until 1938 the typhoid bacillus had been regarded as a single species that could not be further subdivided. In that year Craigie & Yen (1938a, 1938b) made the important discovery that typhoid strains isolated from different outbreaks could be readily distinguished by means of certain specifically adapted Vi-phage preparations. The story of this discovery may be briefly summarized here.

It was known from the work of Hadley (1926), Burnet (1927, 1929) and Levine & Frisch (1934) that the action of bacteriophages on the various *Salmonella* species is closely related to the presence of certain heat-stable "O" antigens in the bacterial cell. As soon as the special importance of the so-called "Vi" antigen of the typhoid bacillus was recognized (Felix & Pitt, 1934), a number of investigators, working independently of each other in different countries, established the existence of bacteriophages that were specific for the Vi form of the typhoid bacillus (Sertic & Boulgakov, 1936; Scholtens, 1936; Craigie & Brandon, 1936). These phages, however, attacked typhoid strains irrespective of their origin, provided the cultures contained an adequate quantity of the Vi antigen.

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Copies of the main scientific periodicals devoted to bacteriology and public health are circulated on a regional basis to all the laboratories of the Service ; in addition, each laboratory is provided with five journals, and is allowed to select two others, for permanent retention. These can be used to build up a small local library, sometimes combined with journals taken by hospital laboratories and local medical societies. There is a larger library at Colindale with a full-time librarian who undertakes to help in tracing references and to obtain, through the National Central Library or by other means, any journal or bound volume that is not in the possession of the Service.

Further exchange of information is provided by the meeting in London five times a year of the heads of laboratories to discuss technical and administrative problems, and to formulate plans for improving the efficiency of the Service.

6. Conclusion

A great deal more might be written about the Service, but enough has already been said to show that an active organization has been built up, operating as a large team on a national scale with central co-ordination and peripheral freedom, capable of applying modern bacteriological knowledge to the diagnosis, control, and prevention of infectious disease, approaching its task essentially from the research angle, co-operating closely with central and local government departments, Regional Hospital Boards, and general practitioners, and straining its utmost to help in the final triumph of preventive medicine over unnecessary sickness and disease.

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The great advance due to the work of Craigie & Yen (1938a) was based on their observation of a special adaptability possessed by one particular anti-Vi phage. When this phage was propagated on typhoid strains isolated from different outbreaks, preparations of bacteriophage were obtained which had developed a high degree of specificity for the particular strain on which they were grown. Strains that were related epidemiologically were invariably found to respond in an identical manner to the different phage preparations, and on this basis Craigie & Yen (1938b) identified a number of distinct Vi-phage types of the typhoid bacillus.

The Vi-phage type of a strain is for all practical purposes a permanent character, and typing of the typhoid bacillus by this means gives results as reliable as those obtained in streptococcal or pneumococcal infections by the use of serological tests. It is thus possible to prove or disprove the connexion between cases of typhoid fever occurring sporadically or during an outbreak, and between a carrier and the cases for whose infection the carrier is thought to be responsible.

The phage-typing method reveals strain differences which cannot be demonstrated by any of the customary serological methods, including cross-agglutination and cross-absorption tests and also phagocytosis and passive-protection tests in mice (Felix & Pitt, unpublished). It appears, therefore, safe to continue employing a single Vi + O strain of the typhoid bacillus for making typhoid vaccine or therapeutic antityphoid serum.

FIG. 1. DISTRIBUTION OF TYPHOID CASES AND CARRIERS IN DEVON, 1941–1944. OLD-STYLE NOTATION

Epidemiological Significance of Typhoid Vi-phage Types

The observations of Craigie and Yen on the epidemiological significance of Vi-phage types of typhoid bacilli were soon amply corroborated by workers in Canada (Brandon, 1940; Desranleau, 1942; Crossley, 1942), China (Yen, 1939), and the United States of America (Lazarus, 1941; Coleman, 1942a). Experiences in Britain led to the conclusion that Vi-phage typing is an indispensable aid to successful epidemiological field work (Felix, 1943).

Two facts of great practical importance contributed to speedy recognition and almost general acceptance of the new typing method, namely, the remarkable constancy of the types and the fact that about 90 per cent of the strains can be typed. A number of striking examples of the stability of the Vi-phage types have been described, of which one may be quoted here. It relates to a small typhoid outbreak in Britain in 1943, due to a hitherto unknown Vi-phage type which was labelled Type T (Felix, 1944). The carrier responsible for the outbreak had acquired the infection during the South African war, more than forty years earlier. Cultures of the strain and the corresponding specific Vi-type phage were, therefore, sent to Professor Pijper and Dr Crocker of Pretoria and it was soon found that Type T bacilli were in 1944 still common in typhoid patients in Johannesburg and Pretoria.

Practical Value of the Typing Method

From my experience during the past ten years it would appear that the lower the incidence of the disease the greater the necessity for using the typing method in every case. When a typhoid outbreak of considerable size occurs it is usually not difficult to detect the carrier concerned. It is the sporadic cases, or small groups of cases, that present the greatest difficulties. This applies to small rural districts as well as to the metropolitan boroughs of a city of the size of London.

The fascinating story of an investigation that ended with the unmasking of a chronic carrier of a strain of Vi-type D4 (Felix, 1943) was published by Bradley (1943). In this instance, 23 apparently sporadic cases occurring in four counties and ten administrative districts, during the course of two years, were traced to a carrier on a farm 100 miles away.

The accompanying two "spot" maps of the county of Devon (figs. 1 and 2), a mainly rural area in south-west England, illustrate the great advance that has been made through the application of Vi-phage typing (Cruickshank, 1947). The county of Devon is one of the largest administrative areas in rural England, covering about 2,000 square miles with a population of half a million; a very careful survey of typhoid fever in this area was conducted by J. C. Cruickshank during 1941–44.

The first map (fig. 1) shows in the old style, i.e., without indicating their Vi-types, the local distribution of 83 typhoid cases and 12 chronic carriers that occurred during this period. The second map (fig. 2), which uses a different symbol for

FIG. 2. DISTRIBUTION OF TYPHOID CASES AND CARRIERS IN DEVON, 1941–1944. Vi-TYPES INDICATED (CRUICKSHANK, 1947)

NOTE. *A letter within a circle denotes a chronic carrier of that type; a letter within a square a chronic carrier who is in a mental hospital.*

each Vi-type, shows that these cases and carriers represented eight entirely separate groups, each one infected with a strain of a different Vi-type. The cases, therefore, originated from at least eight different sources of infection. The topographical distribution makes it probable that the number of active foci was considerably greater. It is clear that the medical officers of health who are called on to investigate sporadic cases in these circumstances are faced with an almost impossible task. The epidemiological investigations cannot lead in the right direction unless the infections that arise concurrently from a number of different sources are first separated one from another. Vi-phage typing is at present the only laboratory method that makes this separation possible.

Typhoid Vi-phage Types Prevalent in Britain

The number of Vi-phage types and sub-types recognized up to 1941 was 18 (Craigie, 1940, 1941). Six additional types were identified by the present writer in Britain (Felix, 1943, 1944). The revised typing scheme now in general use and the complete list of references to the 24 typhoid Vi-phage types and sub-types have been published by Craigie & Felix (1947).

The figures shown in Table I have been calculated from the number of foci from which the cultures have been derived, and not from the number of patients or cultures examined. When Table I is considered in conjunction with Table V, it will be seen that the figures of percentage distribution shown in Table I have been derived from a total of 1,007 foci, involving a total of 1,834 typhoid patients or carriers examined. It is beyond the scope of this paper to give the figures for each of the years 1942–49 separately, but it can be stated that only minor fluctuations in the relative frequency of the different Vi-phage types were observed throughout those eight years. This is entirely due to the adoption of the method of counting the number of foci instead of that of patients or strains examined. Unfortunately, the latter method has been applied by nearly all the workers who have published data on the relative frequency of typhoid Vi-phage types in different parts of the world: Canada (Desranleau, 1947; Desranleau & Martin, 1950), China (Yen, 1939), United States of America (Lazarus, 1941; Morris, Brim & Sellers, 1945), Middle East (Boyd, 1943), South Africa (Crocker, 1947), France (Jude & Nicolle, 1949), Indonesia (Lie, 1949) and India (Dhayagude & Banker, in press). Their data, therefore, cannot be compared with the figures shown in Table I.

Only the following 13 types and sub-types are indigenous to Great Britain: A, B2, C, D1, D2, D4, E1, F1, F2, L2, N, O and T. The few strains of Vi-phage types D5, D6, G, H and J that are listed in Table I were all isolated from patients who gave a definite history of having acquired the infection abroad, or through contact with a case infected abroad. The six remaining Vi-phage types B1, B3, E2, K, L1 and M have not yet been encountered in Britain up to the present time.

"Untypable Vi strains" are those resistant to all the 24 typing phages. "Degraded Vi strains" are those giving overlapping cross-reactions with all, or some, of the typing phages. The table shows that only 12.4 per cent of the

TABLE I. PERCENTAGE DISTRIBUTION OF TYPHOID Vi-PHAGE TYPES IN GREAT BRITAIN*

Vi-phage types	Percentage	Vi-phage types	Percentage
A	27.3	H	0.1
B2	0.2	J	0.6
C	11.3	L2	0.2
D1	5.8	N	2.9
D2	0.5	O	4.5
D4	1.0	T	2.2
D5	0.3	Untypable Vi strains	9.4
D6	0.5		
E1	24.0	Degraded Vi strains (untypable)	3.0
F1	4.2		
F2	0.6	Vi-negative cultures	1.6
G	0.1		

* Average for 8 years, 1942–49.

strains examined belonged to these two groups and thus remained untypable. The Vi-negative cultures need not be added to the untypable strains, because they can be replaced by Vi-positive cultures that are, as a rule, readily typed. It has been pointed out in a previous paper (Felix, 1943) that cultures submitted for phage typing should not be prepared from a single colony, but, whenever possible, from about half a dozen or more selected " smooth " colonies which are seeded together on agar or Dorset egg medium. This is a useful safeguard against the chance selection of a single colony that may be composed of Vi-negative organisms.

b. Typing of Salm. paratyphi B

In many countries, including Britain, paratyphoid-B fever is more prevalent than typhoid fever. It appeared, therefore, highly desirable to investigate the possibility of applying Vi-bacteriophage action to the examination of paratyphoid-B cases and carriers.

The presence in cultures of *Salm. paratyphi B* of an antigen resembling the typhoid Vi antigen was described some years ago (Felix & Pitt, 1936), but most workers paid little attention to this finding. During 1941–43, when large-scale outbreaks of paratyphoid-B fever occurred in Britain, investigations carried out in the Emergency Public Health Laboratory Service led to the recognition of anti-O and anti-Vi bacteriophages acting on *Salm. paratyphi B*, and thus made it possible to apply the bacteriophage technique to the typing of this organism (Felix & Callow, 1943).

Anti-Vi phages can be induced to develop a high degree of specificity for particular paratyphoid-B strains, whereas anti-O phages are incapable of such adaptation. By the use of four different preparations of adapted BVi phage, Felix & Callow (1943) evolved a typing scheme of paratyphoid-B bacilli which in principle is almost identical with that devised by Craigie & Yen (1938a, b) for the typing of typhoid bacilli. The first place in each of the two schemes has been assigned to the type of bacillus that is sensitive to all the adapted phage preparations. The remaining types in the two schemes are characterized by their particular sensitiveness to the homologous adapted type phage.

For some years, up to 1947, the number of Vi-phage types and sub-types of the paratyphoid-B bacillus remained only five, all of which were indigenous to Britain. Nevertheless, nearly 90 per cent of strains isolated in all parts of Britain could be typed by means of the five typing phages. More recently, extensive investigation of those strains that had remained untypable led to the recognition of a further five Vi-types and sub-types, some of which are already known to be quite common in various countries on the continent of Europe, in addition to being indigenous to Britain. The routine typing of *Salm. paratyphi B* is now carried out according to an extended scheme, based on that published by Felix & Callow (1943), and subdividing the organism into ten Vi-phage types and sub-types.

Table II is to be read in conjunction with Table VI, and it will be seen that the averages for the eight years 1942–49 are based on a total of 1,079 foci, comprising a total of 2,398 paratyphoid-B patients and carriers. The relative frequencies of the various BVi-phage types in each of the eight years under observation showed great fluctuations, unlike the frequency distribution of the typhoid Vi-phage types referred to in the preceding section. This will be discussed later in connexion with Table VI.

TABLE II. PERCENTAGE DISTRIBUTION OF PARATYPHOID-B Vi-PHAGE TYPES IN GREAT BRITAIN*

Vi-phage types	Average percentage	Vi-phage types (recently identified)	Average percentage
1	53.6	Beccles	6.8
2	6.1	Taunton	13.4
3a	16.2	Dundee	3.3
3a 1 ...	5.2	B.A.O.R.	0.9
3b	1.2	Newburn	0.3
Untypable BVi strains ...	11.4		
Vi-negative cultures ...	0.3		

* Figures for the recently identified Vi-phage types, provisionally labelled by localities, represent averages for 2 years, 1948 and 1949; all other figures are averages for 8 years, 1942–49. The total average, therefore, is greater than 100.

It is of particular interest to note that the proportion of paratyphoid-B strains that remained untypable is not greater than that of typhoid strains (including degraded Vi strains), in spite of the fact that the number of recognized BVi-phage types was, up to 1947, only five, and is at present only ten, as contrasted with the 24 types and sub-types of the typhoid bacillus. The Vi antigen of *Salm. paratyphi B* is apparently not capable of variation to the same degree as that of *Salm. typhi*, that is to say the former has developed fewer Vi-phage types and sub-types than the latter.

Paratyphoid-B bacilli also do not lose their specific Vi antigen as readily as do typhoid bacilli. Table II shows that only 0.3 per cent of all the strains of *Salm. paratyphi B* isolated during the past eight years in Britain were Vi-negative variants, whereas the corresponding figure for *Salm. typhi* was 1.6 per cent. In the earlier two series reported from Britain for the period 1940–42 there were eight Vi-negative variants among 440 strains of *Salm. typhi* (Felix, 1943), and not a single Vi-negative variant among 714 strains of *Salm. paratyphi B* tested (Felix & Callow, 1943). It is possible that Vi-negative variants of *Salm. paratyphi B* are less uncommon in other parts of the world than they are in Britain. The constancy and epidemiological significance of paratyphoid-B Vi-phage types are of the same high order as those of typhoid Vi-phage types. The first field inquiry, based on the results of the phage typing, into an outbreak of paratyphoid-B fever in a mixed urban and rural area, which was examined bacteriologically by Dr P. H. Martin in Ipswich in 1941, clearly showed that there was complete harmony between the laboratory and the field findings (Hutchinson, 1943). The reliability and usefulness of the method have since been confirmed in investigations of many outbreaks, large and small, in Britain (King, 1944; Wallace & Mackenzie, 1947; Martin, 1947; Tabbush, 1949; Kennedy & Payne, 1950; Cockburn & Jameson, in press; Ministry of Health, 1946, 1947, 1948, 1949), in Canada (Desranleau, 1947; Desranleau & Martin, 1950) and in France (Nicolle, Jude & Buttiaux, 1950).

c. Typing of Salm. paratyphi A

An attempt was recently made, in collaboration with Professor R. G. Dhayagude and Dr D. D. Banker, of Bombay, to type strains of paratyphoid-A bacilli by a similar procedure.

Professor Dhayagude had isolated in Bombay a bacteriophage that appeared to react specifically with strains of *Salm. paratyphi A*. Cross-tests of this phage and a representative collection of members of the *Salmonella* group clearly distinguished this bacteriophage from the numerous anti-O phages that attack many of the *Salmonella* species which share the same O-antigenic components. It is well known that even minor O-antigenic components that are common to the various *Salmonella* species, though they are not listed in the Kauffmann-White diagnostic scheme (Salmonella Subcommittee, 1949), provide an adequate point of attack for anti-O bacteriophages (Felix & Callow, 1943). The Bombay phage was found to be an anti-Vi phage acting on the specific Vi antigen of *Salm. paratyphi A*. The existence of this antigen has been established by Felix & Pitt (1936), but so far most workers have paid very little attention to these findings. Only Bhatnagar, Freeman & Gera (1937) confirmed the presence of Vi-antigen in cultures of a freshly isolated strain of *Salm. paratyphi A*.

The Bombay paratyphoid-A Vi-phage, used in very high dilutions, lysed 83 out of 132 strains of *Salm. paratyphi A* isolated in distant parts of the world. The remaining 49 strains were all insusceptible. The position changed at once when the first adapted phage preparation was obtained, since eight of the insusceptible strains were lysed to titre by the adapted phage. The adaptation of the original Bombay Vi-phage had occurred on a strain isolated in southern Palestine in 1925, and amongst the recently collected cultures that were found to be fully susceptible to the adapted phage was one isolated from a British soldier who had acquired the infection in the same locality in 1947.

The original and the adapted paratyphoid-A Vi-phage are now employed by Dr Banker in Bombay in the routine typing of freshly isolated strains, and there can be little doubt that further Vi-phage types of *Salm. paratyphi A* will be identified, and that a useful typing scheme of this organism will be developed.

d. Typing of Salm. typhi-murium

Salm. typhi-murium is the most common cause of food poisoning in Britain and in many other countries, and the possibility of typing strains from different outbreaks was investigated in the Emergency Public Health Laboratory Service early during the late war. Felix & Callow (1943) showed that *Salm. typhi-murium*, which shares the labile Vi antigen with *Salm. paratyphi B* (Felix & Pitt, 1936), was not lysed by the first four BVi-type phages. *Salm. typhi-murium* was found to be sensitive to its own specific Vi phages, of which only two different types had been identified at the time the paper by Felix & Callow (1943) was published. Subsequently the number of Vi-phage types and sub-types of *Salm. typhi-murium* rose to eleven, and a typing scheme was evolved which, like that for *Salm. paratyphi B*, is built up on the same principle as the original typing scheme of Craigie & Yen (1938a, 1938b) for *Salm. typhi*. Cross-reactions do occur between certain Vi-phage types of *Salm. paratyphi B* and *Salm. typhi-murium*.

The provisional typing scheme of *Salm. typhi-murium* now in use at the Central Enteric Reference Laboratory has not yet been published, pending detailed investigation of some of the relevant points, but the method has been successfully employed in the investigation of a number of outbreaks; the results of some of these investigations have been published already (Gillespie, 1946; Cook & de Costobadie, 1947; Eedy, 1950; Blaxland & Blowers, 1951).

The epidemiological significance of the different Vi-phage types and sub-types of *Salm. typhi-murium* has been established beyond any doubt. The practical value of the bacteriophage-typing of this organism is, however, not as great as that of typhoid and paratyphoid-B Vi-phage typing for the following two reasons. Firstly, a considerable proportion of strains of *Salm. typhi-murium* do not contain the Vi-antigen (Felix & Pitt, 1936) and cannot therefore be typed by the Vi-phage technique. Secondly, chronic carriers of *Salm. typhi-murium* are extremely rare, and play a negligible role in the spread of the infection, and it is in the detection of the chronic carrier that the bacteriophage technique renders the greatest service. For these reasons the typing of *Salm. typhi-murium* strains has not been adopted as a routine in every outbreak or sporadic case, as it has in cases of typhoid and paratyphoid-B fever.

Nevertheless, circumstances may arise in the course of the investigation of an outbreak of food-poisoning due to *Salm. typhi-murium* which compel the epidemiologist to seek guidance, or final confirmation of his findings, from the Vi-phage typing of the cultures isolated from patients, foodstuffs, flocks of poultry or animals, etc. When a careful epidemiological investigation is conducted and its successful conclusion is considered to depend on the application of the phage-typing method, the typing of the cultures is not refused.

It may be stated here that the typing of *Salm. typhi-murium* by means of anti-O phages, recently described by Lilleengen (1948), leads to a different grouping of the strains, cutting across the different Vi-phage types (Felix & Callow, unpublished results). Since the results of Vi-phage typing of *Salm. typhi-murium* invariably agree with the epidemiological findings, it is evident that the grouping by anti-O phages is not of the same significance.

e. Standardization of Enteric Phage Typing

At an early stage in enteric phage typing it became clear that there was need for standardizing the typing procedure in order to avoid faulty technique and consequent confusion. Extensive investigations of the various factors that determine the outcome of the typing tests were, therefore, carried out in close co-operation with Dr James Craigie. As a result of this work a revised typing scheme of *Salm. typhi* and suggestions for the standardization of the technique were published (Craigie & Felix, 1947). These recommendations were approved by a committee of experts at a meeting held in Copenhagen during the Fourth International Congress for Microbiology, July 1947, and were adopted as the provisional International Standard method. The Central Enteric Reference Laboratory of the Public Health Laboratory Service in London now acts as the International Reference Laboratory for Enteric Phage Typing. Standard Vi-phage preparations and the corresponding Vi-type strains are distributed to national reference laboratories in various parts of the world, and these send to the International Reference Laboratory any supposedly new Vi-type strains for confirmation and eventual inclusion in the typing scheme (International Committee for Enteric Phage Typing, 1949).

So far 24 countries have joined the International Scheme, and workers from a number of these countries have worked at the International Reference Laboratory for periods varying from a few days to several weeks. From experience gained during the past three years it can be stated that the outcome

of this co-operative inquiry has proved highly satisfactory. The phage-typing by means of the standardized reagents and technique gives, on the whole, uniform results in the hands of workers in different parts of the world. Five new typhoid Vi-phage types have been identified during this period, in addition to the first 24 types and sub-types, and have been labelled provisionally: No. 25—Lie (Indonesia), No. 26—Clark (Canada), No. 27—Scholtens (Holland), No. 28—Scholtens (Holland), No. 29—Borman (USA).

The results have been reviewed at the Fifth International Congress for Microbiology in Rio de Janeiro, 1950, and it has been decided that the arrangements adopted at the Fourth Congress in 1947 and implemented according to the first report of the International Committee for Enteric Phage Typing (in press), be continued until the Sixth Congress, which is to be held in Rome in 1953.

The reagents required for the typing of paratyphoid-B bacilli according to the scheme suggested by Felix & Callow (1943) have also been standardized in an analogous manner. Up to the present time only the first five typing phages listed in Table II have been available for general distribution, but three of the additional adapted Vi-phages have already been put at the disposal of a number of national reference laboratories even before the extended typing scheme has been published (Felix & Callow, in press). Where the provisional International Standard method has been followed the results have been as satisfactory as those obtained with typhoid Vi-phage typing, for instance in Canada (Desranleau, 1947; Desranleau & Martin, 1950) and in France (Nicolle, Jude & Buttiaux, 1950). In Holland (cf. Scholtens, 1950), where the recommendations were disregarded, the result was complete failure.

Requests have been received from several countries for the supply of the adapted Vi-phages for *Salm. typhi-murium* that have been evolved by Felix and Callow and are in use in the Public Health Laboratory Service. It is regretted that these requests have had to be refused, pending the publication of the typing scheme and the preparation and detailed examination of adequate quantities of standard phage preparations.

2. Detection of Chronic Typhoid and Paratyphoid-B Carriers with the Aid of Vi-Agglutination Tests

a. Chronic Typhoid Carriers

The detection of a chronic carrier is often a difficult task, though the methods of isolating typhoid and paratyphoid bacilli have been greatly improved in the past few years. The main difficulty is that frequently excretion is intermittent, so that repeated examination of the excreta over a long period of time may be necessary.

Most workers now employ the test for the presence of typhoid Vi agglutinins as a preliminary screen for a suspected carrier. Since the test was first suggested by Felix, Krikorian & Reitler (1935), it has been used extensively in many countries, and it has been found that the frequency of a positive Vi reaction in chronic typhoid carriers is remarkably high (Table III).

Similar results were recorded by Bhatnagar (1938) in India, but less favourable results were reported from the Sudan (Horgan & Drysdale, 1940) and Southern Rhodesia (Davis, 1940; Radowsky, 1942).

The practical value of the test is greatly enhanced by the fact that the reaction is independent of intermittency in the excretion of bacilli. Numerous cases have been recorded of chronic carriers yielding negative faecal specimens over periods of many weeks or months. Yet the tests for Vi agglutination which were carried out during those negative intervals gave the same positive result on each occasion and thus encouraged continued search for typhoid bacilli, leading finally to the isolation of the organisms (Schlesinger, 1943; Fry, 1944). From my experience over a period of more than 10 years, it would appear that the test is positive in 9 out of 10 chronic carriers. When the carrier condition has lasted for a very long time, for example, for periods of 30 or 40 or more years, the power of producing Vi antibody often tends to be exhausted.

TABLE III. Vi-AGGLUTINATION TESTS IN CHRONIC TYPHOID CARRIERS

Reference		Locality	Number tested	Number positive	Percentage positive
Giovanardi,	1936	Italy	8	7	87.5
Pijper & Crocker,	1937	S. Africa	6	6	100.0
Felix,	1938a	Gt. Britain, Norway, Hungary	52	49	94.2
Bensted,	1940	India	7	6	85.7
Eliot,	1940	USA	45	43	95.5
Coleman,	1942b	USA	82	62	75.6
Klein,	1943	USA	41	37	90.2
Pijper & Crocker,	1943	S. Africa	7	7	100.0

The question is often asked: in what percentage of persons who are not carriers will the test be positive ? The largest single collection of individuals examined in England up to the present is that of employees of the London Metropolitan Water Board (Mackenzie & Windle Taylor, 1945). The latter found 3.7 per cent of positive reactors among 1,040 healthy waterworks employees, none of whom excreted typhoid bacilli in the faeces or urine. This is not an unduly high number of " false " positive results for a test used as a preliminary screen for " carrier suspects ". It is probable that the figure varies in different localities according to the prevalence of typhoid fever. The positive reactors include persons harbouring typhoid bacilli without excreting them (Felix, 1938a; Pijper & Crocker, 1943) and persons who are harbouring one of those strains of the *Salmonella* or *Bact. coli* groups that are known to possess the typhoid Vi antigen (Kauffmann, 1941).

The Vi test can also be used for the detection among convalescent typhoid patients of those who may pass into the chronic carrier stage and prove a potential menace to the community. The customary three or four negative examinations of the excreta are no guarantee that potential chronic carriers are not discharged from hospitals. Such carriers can be detected by two tests for Vi agglutinins, the first carried out on the eve of discharge from hospital, the second after an interval of about three months. A steady or rising Vi-titre will arouse suspicion of a possible chronic carrier condition; a decreasing Vi-titre or a negative Vi reaction will indicate freedom from infection.

A scheme has now been adopted in Britain for the routine application of the Vi test to every recovered typhoid patient (Ministry of Health, 1945), and this procedure is likely to be the most effective single measure in the control of the chronic carrier. This was illustrated during the large-scale outbreak

which occurred in Aberystwyth in 1946, and which was due to an ice-cream vendor who was a urinary carrier. If the procedure now adopted had been in operation in 1938, when the carrier had his attack of typhoid fever, it is probable that the outbreak would not have occurred, since in 1946 the ice-cream vendor still had a significant Vi-agglutination titre.

b. Standardization of Typhoid Vi-Agglutination Test

The Vi-agglutination test requires greater care than the H or O agglutination tests, but the technique has been much simplified since preserved suspensions were adopted instead of living cultures (Felix, 1938b), and especially since the introduction of Bhatnagar's strain Vi I, which is a pure reagent for the demonstration of typhoid Vi agglutinins (Bhatnagar, Speechly & Singh, 1938). In Britain, the technique of the test has been standardized by the use of a standard agglutinating TVi serum and a standard agglutinable TVi suspension. The necessity for standardizing this and other diagnostic agglutination tests by international agreement has been stressed recently (Felix, 1950), and the suggestion that " International Serum Standards " be adopted has been accepted by the Expert Committee on Biological Standardization of the World Health Organization (World Health Organization, 1950).

c. Chronic Paratyphoid-B Carriers

The Vi-agglutination test originally applied to typhoid alone, but unpublished investigations carried out by the writer in the Emergency Public Health Laboratory Service have shown that the method can also be applied to the examination of paratyphoid-B carriers.

The practical value of the test is, however, not as great in paratyphoid-B as it is in typhoid carriers, for the following two reasons. Firstly, the BVi test is more complicated than the TVi test. An O-inagglutinable " pure " Vi variant of *Salm. paratyphi B*, comparable to Bhatnagar's typhoid strain Vi I, has not yet been isolated, so that the test for BVi agglutinins can only be done after the O agglutinins have been completely removed from the serum by absorption with a Vi-negative culture. At present, therefore, the test cannot be recommended for use in routine laboratories, though it can easily be carried out in a central institute or a reference laboratory. Secondly, the frequency of a significant BVi agglutination in chronic paratyphoid-B carriers is not as high as that of a positive TVi reaction in typhoid carriers. This is due to the fact that the proportion of patients who fail to develop significant H, O, or Vi agglutinins throughout the whole course of the disease is much greater in paratyphoid-B than in typhoid fever.

Nevertheless, the BVi test has proved its value as an auxiliary means of distinguishing between a genuine chronic carrier and a temporary excreter of *Salm. paratyphi B.* Since the proportion of symptomless infections is much greater in paratyphoid-B than in typhoid fever, the question often arises in the course of an epidemiological investigation whether a person who has been found excreting paratyphoid-B bacilli is a chronic carrier, i.e., the true culprit, or a temporary excreter who is merely one of the victims of the outbreak. In the diagnosis of the true carrier the final verdict naturally depends on the result of the bacteriological examination of the excreta, which must be continued for not less than a year, but useful information is often obtained much sooner from two or three examinations of the blood serum at intervals of about six weeks. A decreasing BVi titre will indicate temporary excretion, whereas a steady or rising titre will arouse the suspicion that the person has been, or is likely to become, a chronic carrier of the infection.

In these tests the BO titre is always estimated along with the BVi titre, and, in the absence of BVi agglutinins, equal significance is attributed to a decreasing BO titre. Several examples of the successful application of this procedure have been described (Wallace & Mackenzie, 1947; Ministry of Health, 1948; Cockburn & Jameson, in press). The tests are also employed in an analogous manner in the control of recovered paratyphoid-B patients.

3. The Central Enteric Reference Laboratory and Bureau

At the beginning of the war of 1939–45 the Emergency Public Health Laboratory Service established a special laboratory for serological and immunological work on the enteric fevers. Since 1940 this laboratory has also served as a central reference laboratory to which cultures of typhoid and paratyphoid-B bacilli isolated in public health or clinical laboratories in any part of England, Wales, Scotland and Northern Ireland have been submitted for typing by the bacteriophage technique. Records were kept of every person who had suffered from typhoid or paratyphoid infection, with his or her address, occupation, Vi-phage type of the infecting organism, etc. These records, though very incomplete during the early years, soon proved to be of the greatest value to those concerned in field investigations. The information furnished by the laboratory often provided the only link between sporadic cases scattered over several counties and many administrative districts. A number of epidemiological investigations conducted on a nation-wide scale were made

TABLE IV. NOTIFIED CASES OF ENTERIC FEVERS IN ENGLAND AND WALES*

Year	Typhoid fever	Paratyphoid fever†	Total typhoid and paratyphoid fevers
Median for 10 years 1930–39	—	—	1992
1938	—	—	1322
1939	—	—	1479
1940	—	—	2833
1941 January–June ...	—	—	1145 } 4763
1941 July–December	677	2941	3618 }
1942	468	390	858
1943	374	319	693
1944	284	257	541
1945	287	231	518
1946	480	732	1212
1947	275	412	687
1948	348	373	721
1949	280	580	860

* From the beginning of 1944 the figures are the "corrected" notifications of the General Register Office (i.e., corrected on the basis of subsequently notified change in diagnosis).

† The figures represent almost exclusively cases of paratyphoid B, since the number of cases of paratyphoid A and C is negligible.

possible only by the fact that they were based on information accumulated in the records of a central reference laboratory.

The incidence of typhoid and paratyphoid fevers in Britain has been very low during the past few years. There was a considerable increase during the first two years of the war, owing to numerous large outbreaks of paratyphoid-B fever, but since 1942 the numbers have been very low indeed. The figures for England and Wales, shown in Table IV, refer to a population of about 43 million. Although bacteriological differentiation into typhoid and paratyphoid fever has been possible in some areas for many years, it was not until July 1941 that it became practicable to separate the two diseases in the weekly returns of the General Register Office. Table IV has been reconstructed from this source. It shows that it is hardly justifiable in Britain to continue to include the enteric fevers among the so-called common fevers.

It would be wrong, however, to assume that the two diseases are already in process of extinction in Britain, as some recent writings suggest. Scott (1941) very aptly remarked that " there is an unextinguished residuum due to causes resistant to existing preventive measures ", and Table IV shows how our statistics were again upset in 1946 through one outbreak of typhoid and two outbreaks of paratyphoid-B fever, comprising 209, 179 and 104 cases, respectively (Ministry of Health, 1948). The advances in laboratory methods described in this paper seem to make it possible to get rid of that " residuum ".

Because of the low incidence of the disease, it was considered opportune at the end of the late war to continue to maintain permanently a so-called Central Enteric Reference Laboratory to serve for the whole of Britain, i.e., for a population of about 50 million. In January 1948 an important change took place in the status of the laboratory, when it assumed the function of a Central Enteric Bureau for the purpose of collecting all information about cases and carriers of enteric fever in Great Britain. The records that had been kept in the laboratory since 1940 served as a nucleus for a central register of cases and carriers, arranged according to the Vi-phage type of typhoid or paratyphoid-B bacilli with which each of the patients had been, or is, infected. Medical officers of health are asked to co-operate in providing the information necessary to render this register as complete as possible. In return, they may make full use of the centralized records when investigating fresh cases in their districts. Tables V and VI give an indication of the scope of the work of this laboratory and bureau.

Although Tables V and VI have been arranged primarily to show the percentage of strains of *Salm. typhi* and *Salm. paratyphi B* that could not be typed with the typing phages so far available, the figures also give useful information on a number of other points of more general interest. As mentioned before, these two tables should be read in conjunction with the corresponding Tables I and II.

a. Calculation of Frequency Distribution of Types and of Untypable Strains

Unquestionably, the only correct method of ascertaining the frequency distribution of the various types is that based on the number of foci due to infection with a given Vi-phage type. Yet nearly all the data published up to the present are based on the number of persons from whom cultures have been isolated, or, what is even worse, in some instances on the

TABLE V. TYPHOID FEVER IN GREAT BRITAIN: PERCENTAGE OF UNTYPABLE OUTBREAKS OR CASES, AND OTHER RELEVANT DATA

Year	1942	1943	1944	1945	1946	1947	1948	1949	Total
Part I (Great Britain)									
Total number of cultures examined	228	342	217	250	369	344	663	479	2892
Total number of patients and carriers examined...	171	198	169	178	297	272	280	269	1834
Total number of foci counted. (Single cases, carriers and outbreaks, irrespective of number of cases involved, counted as one focus each.) ...	82	100	111	132	140	161	150	131	1007
Percentage of strains of *Salm. typhi* (counted by foci) that remained untypable by means of 24 Vi-type phages (Craigie & Felix, 1947)	12.2	6.0	13.5	13.0	10.7	13.7	9.4	20.6	12.4
Part II (England and Wales)									
Notified cases of typhoid fever in England and Wales. (From the beginning of 1944 the figures are the " corrected " notifications of the General Register Office.) ...	468	374	284	287	480	275	348	280	2796

TABLE VI. PARATYPHOID-B FEVER IN GREAT BRITAIN: PERCENTAGE OF UNTYPABLE OUTBREAKS OR CASES, AND OTHER RELEVANT DATA

Year	1942	1943	1944	1945	1946	1947	1948	1949	Total
Part I (Great Britain)									
Total number of cultures examined	129	150	264	302	571	460	517	746	3139
Total number of patients and carriers examined...	85	125	182	180	453	361	412	600	2398
Total number of foci counted. (Single cases, carriers and outbreaks, irrespective of number of cases involved, counted as one focus each.) ...	55	85	95	111	159	149	192	233	1079
Percentage of strains of *Salm. paratyphi B* (counted by foci) that remained untypable by means of first five Vi-type phages (Felix & Callow, 1943)	12.7	9.4	8.5	17.1	10.7	13.4	44.7	23.6	17.5
Percentage of strains of *Salm. paratyphi B* (counted by foci) that remained untypable by means of first ten Vi-type phages (Felix & Callow, in press)	—	—	—	—	—	—	11.9	7.3	9.6
Part II (England and Wales)									
Notified cases of paratyphoid fever in England and Wales. (From the beginning of 1944 the figures are the " corrected " notifications of the General Register Office.)	390	319	257	231	732	412	373	580	3294

number of cultures examined. There can be no doubt that a true picture of the relative frequencies of Vi-phage types in various countries, or of their activity in a given country over a period of years, can only be obtained by counting the number of foci of infection.

This makes it imperative for the laboratory to work in the closest co-operation with the epidemiologist, for without such co-operation enteric phage typing would be without any value for the control of the disease and need not be done at all. It is, of course, not always possible to decide whether or not cases occurring in a given district within a limited period of time belong to the same focus. The figures shown in Tables V and VI were compiled by counting as *one* any number of sporadic cases that were known to be connected with each other, whereas those cases in which such relationship was unknown or doubtful were each counted separately. This method still leaves a wide margin of error, but the main purpose of applying it is to avoid the obvious error that would result if outbreaks involving tens or hundreds of cases were not counted as a single focus; to do otherwise is to mask the true distribution of the different Vi-phage types.

b. Degree of Completeness of Central Enteric Register

A survey of this kind obviously could not provide valid information if it were based on the typing of only a small fraction of the total number of cases occurring in the country. A comparison of the number of patients and carriers examined each year (Tables V and VI, Part I) with the corresponding figure of official notifications (Tables V and VI, Part II) shows how, in the course of the years, the central register of phage-typed cases and carriers has become more complete. It should be noted that in Tables V and VI, Part I refers to the whole of Britain (population 50 million), whereas Part II records notifications in England and Wales only (population 43 million). When due allowance is made for this discrepancy, it is nevertheless clear that the register is gradually reaching a degree of completeness sufficient to provide the basis for epidemiological investigation of isolated cases occurring in widely separated areas. The figures may also serve as a measure of the wholehearted co-operation on the part of medical officers of health, clinicians, and bacteriologists throughout the country.

c. Number of Typhoid and Paratyphoid-B Foci in Britain

Although the incidence of paratyphoid-B fever, during the period under investigation, was on the whole higher than that of typhoid fever, it is seen from Tables V and VI that the reverse was often found with regard to the number of foci counted in each of the eight years separately. This interesting point has been commented upon in an earlier paper (Felix, 1943), and indicates that the number of endemic typhoid foci, maintained by chronic carriers, in Great Britain is probably greater than the number of endemic foci of paratyphoid-B infection.

No attempt has yet been made to compile a complete register of chronic typhoid and paratyphoid-B carriers who have been infected in earlier years and are known to the public health departments and laboratories throughout the country. Before this is done these carriers or carrier suspects will have to be re-examined bacteriologically and serologically to establish whether they are in fact persistent carriers and to which Vi-phage type the organism they carry belongs. Only a central register that is being kept complete and up to date can provide the basis for stricter supervision of known and potential typhoid and paratyphoid-B carriers.

d. Introduction into Britain of Unknown Typhoid and Paratyphoid-B Vi-Phage Types

Early during the war years it became apparent that Vi-phage types that were not prevalent in Great Britain were being introduced from abroad (Felix, 1944). Since the end of the war the return of millions of demobilized soldiers and the re-opening of tourist traffic have greatly accelerated this process. Tables V and VI show that the percentage of " untypable " strains of typhoid and paratyphoid-B bacilli in Great Britain has increased during the post-war years. The increase has been greater with *Salm. paratyphi B* than with *Salm. typhi.* From data accumulated at the Enteric Bureau it is known that a considerable proportion of " untypable " strains have been isolated from patients who gave a definite history of having acquired the infection abroad.

Table VI shows the sharp rise in 1948 in the percentage of outbreaks or cases of paratyphoid-B fever that were untypable by means of the first five Vi-type phages. As soon as the five additional Vi-phage types that are listed in Table II were recognized, the percentage of untypable strains was again reduced to approximately the original figure.

During the year 1949 one of the recently identified paratyphoid-B Vi-phage types, provisionally labelled Type " Dundee ", was on several occasions introduced by British tourists returning from France. According to information received from Dr P. Nicolle, Director of the National Reference Laboratory for Enteric Phage Typing at the Institut Pasteur, Paris, widespread outbreaks due to Vi-phage Type " Dundee " had occurred in France during the spring and summer of 1949 (Nicolle *et al.* 1950).

e. Administrative Problems in Countries with Low and High Incidence of Enteric Fevers

Great emphasis has been laid in this paper on the necessity for focusing laboratory control of the enteric fevers on a central laboratory and a central bureau serving the whole of the country. This is certainly a necessary pre-requisite for success in those countries where the incidence of the enteric fevers is as low as it is in Great Britain. Where the incidence is high, the administrative problems are, however, different, and it is well known that there are countries with an incidence of typhoid fever 50 or 100 times greater than that in Great Britain.

It has been mentioned before that for purposes of standardization of the technique and reagents for enteric phage typing, each of the countries that has joined the International Scheme is represented by a national reference laboratory. Within its own sphere of action, however, each national reference laboratory makes arrangements according to local conditions. For instance, in Poland phage typing is at present carried out in six regional laboratories, in Italy in four regional laboratories, and so on.

It is obvious that the new laboratory methods have put the epidemiological investigation of the enteric fevers on an entirely new basis. The public health authorities are now in a position to re-organize and intensify the campaign against the chronic carrier. It appears to be possible to devise a long-term policy, based on close co-operation between epidemiologist, clinician, and laboratory worker, that might in time lead to the complete eradication of enteric infection.

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THE SALMONELLA REFERENCE LABORATORY

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It has long been recognized that certain gram-negative bacilli are associated with disease affecting the intestinal tract of both man and animals. Many investigations of these organisms were undertaken in various parts of the world. In Great Britain early in 1921, the Ministry of Health invited the co-operation of the Medical Research Council in the promotion of a scheme of investigation into outbreaks of food-poisoning; Dr W. G. Savage, Medical Officer of Health for Somersetshire, and Mr P. Bruce White were placed in charge of the investigations. Bruce White did the pioneer work on the antigenic analysis of members of what is now known as the *Salmonella* group, making use of symbols and formulae to record his results (Savage & White, 1925). His work was followed up by F. Kauffmann who used a different system of labelling, the latter finally being adopted by the International Society for Microbiology for general use under the designation Kauffmann-White Scheme. W. M. Scott, working at the Ministry of Health's laboratory, rapidly applied Bruce White's methods to the routine examination of food-poisoning strains, and from 1923 to his death in 1941 we have his figures giving the salmonella types isolated in this country. These figures were published annually from 1923 to 1939 in the Reports of the Chief Medical Officer. Scott's work was continued in the Emergency Public Health Laboratory at Oxford.

1. Origin of the Salmonella Reference Laboratory

From the end of 1941 until January 1946 large quantities of American spray-dried egg powder were imported into Great Britain. A knowledge of the frequency of salmonella infections among poultry in the USA and the almost inevitable contamination of the egg mixture with infected faeces led to the routine examination of the egg powder by the Ministry of Food's Bacteriological Laboratory and by the Emergency Public Health Laboratory Service. Food-poisoning organisms isolated were sent to the Oxford Laboratory for final identification. At the same time many unusual salmonella types were received from cases of human disease—types unknown in this country prior to 1942. It was soon obvious that these unusual types were occurring in the same proportions and were of the same types as those found in American dried egg powder (Medical Research Council, 1947). It was apparent, as a result of this work, that the identification at a central laboratory of salmonella organisms from different parts of the country, and from various foodstuffs, was of value in studying the distribution of potential and actual sources of infection. A whole-time Salmonella Reference Laboratory was therefore established in Oxford in 1945. In March of the following year it was moved to the Central Public Health Laboratory at Colindale in north London. In 1949 the Laboratory was recognized by the World Health Organization as the salmonella reference laboratory for the British Commonwealth. The International Salmonella Centre, Copenhagen, with Kauffmann in charge, reopened in January, 1949; this laboratory was recognized as the world centre for salmonella identification. The Enteric Bacteriology Laboratories, Communicable Diseases Centre, Chamblee, Georgia, under the direction of P. R. Edwards, was recognized as the reference laboratory for the Americas. All three laboratories work closely together, exchanging cultures and verifying both their own findings and those of other investigators.

2. Identification of Salmonella Types

The Salmonella Reference Laboratory receives cultures for identification from all parts of the British Isles and, in addition, from many laboratories in other parts of the world. The majority of strains have been isolated from human sources by public health or hospital laboratories, but a considerable number have come from material handled by veterinary research laboratories, and the regional laboratories of the Ministry of Agriculture; also from laboratories concerned with water-supplies, and laboratories of the Ministries of Health and of Food. Strains are also received from other reference laboratories in the Central Public Health Laboratory, notably the Food Hygiene Laboratory and the Enteric Reference Laboratory. It will be seen that salmonella organisms from a wide variety of sources are investigated. These sources include humans (patients, contacts and symptomless excreters of salmonellae); animals which are ill on the farm, have been killed in the abattoir or have died in zoological gardens; vermin; domestic pets; eggs and prepared foods, water, and sewage.

Cultures are usually received either in the dried state or on Dorset egg medium, because those on nutrient agar may become rough. They are plated to ensure purity, and then tested for their power to ferment sugars, for their production of urease and indole, and for certain other biochemical properties. A full antigenic analysis of each culture is carried out in order to identify the component parts of the somatic and flagellar complexes. For this purpose a large variety of O and H sera are prepared from known classical strains. Some salmonella types differ from other closely related types only in a small part of the full flagellar complex; for the rapid detection of such differences, monospecific sera are made by the absorption of unwanted factors from the serum. Certain organisms, such as *Salm. enteritidis*, may be divided by the use of special biochemical tests into sub-types, each of which has a different epidemiological significance. Some salmonella organisms are able to produce two different serological types of flagella; e.g. *Salm. paratyphi B* (*Bact. schottmuelleri*), may occur as H = b or as H = 1,2. For full identification, therefore,

TABLE I. SALMONELLA STRAINS ISOLATED FROM HUMANS AND ANIMALS IN UNITED KINGDOM IN 1949
(identified by Salmonella Reference Laboratory)

TYPE	NUMBER OF STRAINS									
	Humans		Swine	Cattle	Sheep	Poultry	Laboratory Animals		Domestic pets	Miscellaneous
	Total	Symptomless excreters					Guinea-pigs	Mice		
Salm. *aberdeen*	4	—	—	—	—	—	—	—	—	
,, *adelaide*	1	—	—	—	—	—	—	—	—	
,, *anatum*	10	1	—	—	—	—	—	—	1	
,, *bareilly*	5	3	—	—	—	—	—	—	—	
,, *bovis-morbificans*	14	1	—	—	—	—	—	5	—	rat 1
,, *brancaster*	—	—	1	—	—	—	—	—	—	
,, *brandenberg*	2	—	—	—	—	—	—	—	—	
,, *butantan*	2	—	—	—	—	—	—	—	—	
,, *chester*	1		—	—	—	—	—	—	—	
,, *cholerae-suis*	2		—	—	—	—	—	—	—	
,, *concord*	1		—	—	—	—	—	—	—	
,, *derby*	1	—	—	—	—	—	—	—	—	
,, *dublin*	32	2	—	112	3	2	3	—	—	
,, *enteritidis* var *danysz*	3	1	—	—	—	—	—	—	—	rats 15
,, ,, ,, *essen*	5	—	—	—	—	—	—	—	—	
,, ,, ,, *jena*	63	2	—	—	—	—	8	2	—	
,, *gallinarum*	—	—	—	—	—	3	—	—	—	
,, *give*	3	—	—	—	—	—	—	—	—	
,, *kottbus*	1	—	—	—	—	—	—	—	—	
,, *marseille*	1	1	—	—	—	—	—	—	—	
,, *meleagridis*	2	1	1	—	—	—	—	—	—	
,, *menston*	8	—	—	—	—	—	—	—	—	
,, *montevideo*	10	—	—	—	—	—	—	—	1	
,, *muenster*	5	—	—	—	—	—	—	—	—	
,, *newport*	60	13	3	—	—	—	—	—	—	
,, *oranienburg*	13	1	—	—	—	—	—	—	—	
,, *oregon*	3	—	—	—	—	—	—	—	—	
,, *poona*	1	1	—	—	—	—	—	—	—	
,, *potsdam*	1	1	—	—	—	—	—	—	—	
,, *pullorum*	—	—	—	—	—	5	—	—	—	
,, *saint-paul*	2	1	—	—	—	—	—	—	—	
,, *san-diego*	2	—	—	—	—	—	—	—	—	
,, *senftenberg*	1	1	—	—	—	—	—	—	—	
,, *stanley*	10	—	—	—	—	—	—	—	—	
,, *sundsvall*	1	—	—	—	—	—	—	—	—	
,, *tennessee*	1	—	—	—	—	—	—	—	—	
,, *thompson*	95	9	—	2	—	3	—	—	—	
,, *typhi*	25	7	—	—	—	—	—	—	—	
,, *typhi-murium*	629	18	3	4	1	12	7	—	5	rabbits 2 penguin 1
,, *paratyphi* A	3	—	—	—	—	—	—	—	—	
,, ,, B	100	7	—	—	—	—	—	—	1	
,, ,, C	1	—	—	—	—	—	—	—	—	
,, *worthington*	1	—	—	—	—	—	—	—	—	

special biochemical tests, as well as the isolation of different serological phases of an organism, are carried out. A number of new and hitherto undescribed types of salmonella organisms are received each year; these need special investigation, including the preparation and absorption of sera made from both the new and the classical salmonella types. During the year 1949, five new types were received from Mr R. C. Telling, Dar-es-Salaam, Tanganyika and two new types from Mr L. G. Fairchild, Chingola, N. Rhodesia.

3. Salmonella Strains Isolated in the United Kingdom

Table I shows the distribution of the various types of salmonellae isolated from human and animal sources during 1949.

In addition, during the same year, the following organisms were isolated from foodstuffs (those marked * were associated with food-poisoning in human beings):

Salm. aberdeen—chinese frozen egg 1, pork pie 4.*
Salm. cholerae-suis var. *kunzendorf*—dried egg 1.
Salm. dublin—milk 1.*
Salm. newport—dried egg 1.
Salm. oranienburg—shell-fish 1.
Salm. typhi-murium—cream 1, fish-pie 1, gelatin 1, milk 2,* pudding 1,* cake 1,* custard 1,* duck egg 3,* sausage-meat, commercial pudding mixture 1,* meat paste 1.*
Salm. thompson—ice-cream.*

From these figures it is obvious that *Salm. typhi-murium* has been isolated from a wider variety of sources than any other member of the salmonella group. It has been found that this organism is responsible for about 75 per cent of human infections recorded in England and Wales. It is probable that its wide distribution in the animal kingdom is related to the high incidence of human disease.

a. Change in Distribution During the last Decade

As stated earlier in this paper, a sudden influx of new salmonella types, of which *Salm. oranienburg* is one, into the United Kingdom occurred as the result of the import of American dried egg. This change was noted not only in human salmonella infections but also in animals, the new types being isolated from swine, poultry, and other animals infected from dried egg used in their feeding material. These new types still occur, but as a result of the restriction on dried egg imports in 1946 the proportion has fallen very considerably so that the type distribution of different salmonella strains now more nearly approaches that seen prior to 1942.

From Table II the order of frequency of all salmonella types in human infections in 1949 can be seen. Figures for the years 1940 and 1944 (the latter being a year in which dried eggs were generally distributed) are given for comparison.

TABLE II. COMMONEST SALMONELLA TYPES ISOLATED FROM HUMAN BEINGS IN ENGLAND, WALES AND N. IRELAND

TYPE	1940		1944		1949	
	Number examined	Percentage of total of all types isolated (139)	Number examined	Percentage of total of all types isolated (453)	Number examined	Percentage of total of all types isolated (997)
Salm. typhi-murium ...	45	32.4	185	40.8	629	63.1
,, *thompson*	25	18.0	20	4.4	95	9.5
,, *enteritidis*	18	13.0	55	12.1	71	7.1
,, *newport*...	13	9.4	91	20.1	60	6.0
,, *dublin* ...	5	3.6	1	0.2	32	3.2
,, *oranienburg*... ...	—	—	36	8.0	13	1.3

TABLE III. AGE DISTRIBUTION OF SALMONELLA INFECTIONS IN HUMAN CASES IN ENGLAND, WALES AND N. IRELAND IN 1949 (cultures identified in Salmonella Reference Laboratory)

	AGE-GROUPS (YEARS)								
	0–4	5–9	10–19	20–29	30–39	40–49	50–59	60–69	70+
Number of recorded cases	253	62	93	85	72	68	55	43	33
Number of fatal cases	6	—	—	—	1	4	4	5	8

b. Age Distribution and Fatality

As has been found in other parts of the world, the greatest number of human infections in England, Wales and N. Ireland occurs in those under five years of age, whereas the greatest number of fatal infections occurs in the very young and the very old (Table III).

4. Distribution of Salmonella Types in Various Countries

Table IV gives the commonest salmonella types, excluding *Salm. typhi* and *Salm. paratyphi A*, *B*, and *C*, isolated from man in various countries other than the United Kingdom. The table shows the strains most common in each country, for differing periods from 1934 to 1949. The figures are taken from those published by Edwards, Bruner & Moran (1948) for the USA, Atkinson, Woodroofe & Macbeth (1947) for

TABLE IV. COMMONEST SALMONELLA STRAINS ISOLATED FROM HUMAN CASES IN COUNTRIES OTHER THAN ENGLAND, WALES AND N. IRELAND

TYPE	NUMBER OF TYPES ISOLATED					
	USA	Canada	Australia	Northern France	Uruguay	Puerto Rico
Salm. typhi-murium	469	99	50	19	117	10
,, *newport* ...	310	61	—	—	67	2
,, *oranienburg*	228	25	—	—	—	—
,, *montevideo* ...	187	—	—	—	24	—
,, *anatum* ...	165	—	—	—	17	—
,, *bovis-morbificans* ...	—	—	15	—	—	—
,, *atherton* ...	—	—	31*	—	—	—
,, *derby* ...	—	—	4	—	16	2
,, *newington* ...	—	—	5	—	—	—
,, *thompson* ...	—	57	—	—	—	—
,, *bareilly* ...	—	11	—	—	—	—
,, *panama* ...	—	—	—	—	—	2

* All strains from a single outbreak of gastroenteritis

Australia, Ranta & Dolman (1947) for Canada, Buttiaux, Le Minor & Kesteloot (1950) for Northern France, and Felsenfeld, González & Young (1948) for Puerto Rico; Hormaeche & Peluffo (1941) give figures for salmonella infections in infancy in Uruguay.

5. Salmonella Surveys

Much research work on the natural reservoirs of salmonella organisms is being done by the area laboratories of the Public Health Laboratory Service, which are collaborating in surveys to determine the carrier-rate in healthy human beings, animals used for food, duck eggs, and other sources. Some laboratories are concerned particularly with the ways in which family outbreaks commonly arise, and with the period of excretion. The information obtained is collected by the Reference Laboratory, as it can then be related to the natural distribution of disease in man and animals.

6. Epidemiological Function of the Laboratory

To the ordinary diagnostic bacteriologist a multiplicity of serological or other types of a given organism is a mere nuisance: to the epidemiologist, on the other hand, it is a boon. The identification of the yearly increasing number of serotypes renders the work of the Salmonella Reference Laboratory of great epidemiological value. By watching the distribution of the different types throughout the country and noting the changes in their time, place, and source of origin, it is in a position to help anyone who attempts to investigate particular outbreaks of the disease.

Another epidemiological function of this Laboratory is its ability to draw attention to problems the existence of which would not otherwise be realized. When, for example, strains of an uncommon type of *Salmonella*, isolated from what appear to be sporadic cases of food-poisoning, are sent to the Reference Laboratory for identification from a number of different area laboratories within a short period of time, it becomes clear at once that there must be some common source of infection, even though none of the individual laboratories dispatching the strains had any reason to suspect it. One instance, out of many, may be used to illustrate this. During August 1943, a number of unidentified strains of *Salmonell* were sent in from several separate laboratories in Lancashir and Cheshire. Investigation showed that all of them belonge to a type of organism not hitherto met with in this country– *Salm. sundsvall*. An epidemiological inquiry was set on foo immediately. Inquiry revealed the occurrence of furthe cases in the same or related households. All of the patient that could be traced—and these probably represented only proportion of the total sufferers—admitted to having eate trifle at a particular week-end, either in Liverpool or in som neighbouring area. Further investigation showed that all th trifle had been prepared by a large firm of Liverpool caterer and had been offered for sale in the company's restaurant i Liverpool itself or in one of the multiple retail shops, 122 i all, to which it was distributed in the surrounding districts. The origin of the organism was almost certainly spray-drie egg, which had been used in the preparation of the trifle.

7. The Future

There seems no limit to the number of separate salmonella types that can be recognized; each year sees an appreciable addition to the list. The identification of these new types will continue to be one of the major occupations of the Reference Laboratory.

Interest, however, is bound to widen, and attention will probably be directed more and more to a study of other members of the *Enterobacteriaceae*—apart from *Shigella*—that appear to be concerned in the genesis of intestinal disease in man and animals. Already considerable progress has been made in the characterization of particular strains of *Bact. coli* that are closely associated with neonatal and infantile diarrhoea. The wide group of paracolon bacilli requires investigation, and other smaller groups, at present hardly defined, await systematic study.

The Reference Laboratory will continue to serve as the focus of information for salmonella infections throughout the country and will, it is hoped, be of continual value to bacteriologists and epidemiologists alike. In addition, by its research on new problems, it may confidently look forward to extending the boundaries of our present knowledge and doing something to clarify our ignorance of the nature, causation, and means of spread of much of our food-borne disease.

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FOOD-POISONING AND FOOD HYGIENE

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1 Staphylococcal food-poisoning
2 The indeterminate group of food-poisoning organisms
3 Vehicles of infection
4 The Food Hygiene Laboratory
5 Kitchen hygiene
6 Conclusions
References

From 1939 to 1948 there were 4,877 outbreaks or sporadic cases of food-poisoning reported to the Ministry of Health by medical officers of health. (An " outbreak " means two or more related cases in different families ; a " sporadic case " means a single case which has not been related to other cases or carriers in the same period of time.) Of 3,495 incidents investigated by the Public Health Laboratory Service from 1941 to 1948 approximately 91% were caused by organisms of the *Salmonella* group, 3% by staphylococcal enterotoxin, 2% by " other bacteria ", 0.3% by chemicals ; and 4% were ascribed to " unknown causes " (Public Health Laboratory Service, 1950). The figures are by no means comprehensive ; they merely serve to show the proportions of outbreaks that may be put into the different groups and the general rise, which still continues, in reported incidents. It is pointed out that of the incidence attributable to the *Salmonella* group 91% were sporadic cases. Sporadic cases were not reported in any other group although it is known that they occur ; recovery in the milder types of food-poisoning may be rapid and often the doctor is not consulted.

The steady increase in recorded food-poisoning is partly spurious—owing to better reporting—and partly genuine. Much of it is associated with a change in the habit of the British public from eating at home to eating out ; during and since the war there has been a great increase in the number of canteens supplying meals to schools, factories, and the public in general. War-time economies such as inadequate refrigeration, the scarcity of foodstuffs leading to an inevitable reluctance to discard " left-overs" and to a higher proportion of made-up meat dishes in the dietary, together with shortage of soap, towels and other such commodities, have multiplied the opportunities for food contamination. The results may pass almost unnoticed in small households, but they are magnified a hundredfold in overcrowded and often ill-equipped canteens. Faults in food hygiene due to the carelessness of food-handlers, who for the most part have inadequate knowledge of kitchen hygiene and little training in the storage of cooked foods, must have increased with the influx of untrained workers to help in canteens.

The part played by members of the *Salmonella* group in the causation of food-poisoning is well known, and is dealt with to some extent by Joan Taylor in the article in this Bulletin[1] on the work of the Salmonella Reference Laboratory. In the present article it will be more profitable to consider the less common types of food-poisoning, and to describe briefly the functions of the Food Hygiene Laboratory.

1. Staphylococcal Food-Poisoning

In outbreaks of staphylococcal enterotoxin food-poisoning, when the infective organism has been isolated from the foodstuff, the typing of staphylococci both by the bacteriophage method (Wilson & Atkinson, 1945), and by agglutination (Cowan, 1939 ; Christie & Keogh, 1940 ; Hobbs, 1948) has been invaluable in tracing the infective organism to the nose and hands of a particular food-handler. There are many recorded outbreaks in which the reservoir of infection was found by this means. For example, Williams *et al.* (1946) described three outbreaks caused by ice-cream, and Allison, Hobbs & Martin (1949) described an unusually extensive outbreak in which investigation showed that the glaze of a cooked meat product prepared in a factory had become heavily contaminated by staphylococci introduced, as in the ice-cream, from the nose and hands of those engaged in its preparation. It has been suggested by Fairbrother & Southall (1950) that faeces may be the source of infection in staphylococcal food-poisoning.

There are, as yet, no laboratory methods for recognizing the presence of enterotoxin in food ; it is essential therefore to isolate and type the organism responsible before it is worth while examining the food-handlers. Most staphylococci isolated from toxic food fall into a small number of bacteriophage and serological types (Allison, 1948). Unfortunately these types are fairly widespread among the general population and it is therefore not justifiable to incriminate food-handlers harbouring such types unless the same types have first been isolated from suspected foodstuffs handled by them.

There is no exact information on the minimum number of staphylococci required to produce sufficient enterotoxin in various foodstuffs to cause symptoms. In foods from which an almost pure culture of staphylococci is obtained counts varying from a few millions to thousands of millions per g. have been found. A plate count affords some indication as to whether bacterial toxins have been produced, since it must be assumed that toxic substances will develop in sufficient quantity only when the count is fairly high—over a million per g. of material. In heavily contaminated material, however, it is impossible to estimate the number of staphylococci present, since they are usually isolated only by means of enrichment through cooked meat medium containing 10% of salt (Chapman, 1945), though the introduction of Ludlam's medium may in future enable a direct count to be made (Ludlam, 1949). If the food has been heated after bacterial multiplication has occurred, then culturally it may appear to be sterile, although heat-resistant toxins may still be present. Direct microscopic examination should, however, reveal the nature and extent of the flora before heat treatment.

It may be noted that coagulase-positive staphylococci, particularly those of the food-poisoning type, are rarely found in normal foodstuffs.

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[1] See p. 163.

2. The Indeterminate Group of Food-Poisoning Organisms

This group comprises those numerous outbreaks of food-poisoning in which no recognized pathogenic bacterium can be found and in which chemical analysis fails to reveal the presence of known poisons. There is reason to believe that many of these outbreaks are caused by the inordinate growth of organisms which are harmless when ingested in small numbers. Whether the massive bacterial contamination results in the formation of toxic products from the food, or whether the organisms when present in very large numbers give rise to an actual infection of the gut, it is too early as yet to say ; possibly some organisms act in one way, some in the other. The process of study and differentiation of this group is still in its infancy, but we are already beginning to obtain fairly convincing evidence of the part played by some normally non-pathogenic organisms in the causation of food-poisoning.

For some time past a clinical type of food-poisoning has been recognized with an incubation period midway between that characteristic of staphylococcal enterotoxin with its very rapid onset and that characteristic of salmonella infection with its delayed onset. Anaerobic spore-bearing bacilli had been reported as the causative organism in a few outbreaks of food-poisoning (Knox & MacDonald, 1943 ; Duncan, 1944), and *Clostridium welchii* had been suspected, on more than one occasion, both here and in the United States of America (McClung, 1945).

Following the reported outbreak of enteritis in Hamburg, due to heat-resistant *Cl. welchii* Type F (Zeissler & Rassfeld-Sternberg, 1949 ; Oakley, 1949), a study of the direct microscopic appearance of suspected foodstuffs was made for such organisms. This led to a strong suspicion that gram-positive spore-bearing bacilli in cold or warmed-up meat dishes were responsible for certain outbreaks of food-poisoning occurring in school and factory canteens. These outbreaks were distinguished by an incubation period of 12–18 hours, the occurrence of abdominal pain and diarrhoea without, as a rule, nausea or vomiting, and the short duration of the illness—normally one day or less. *Cl. welchii*, of a type presenting unusual cultural appearances and resisting steaming for one to three or more hours, was isolated from these foods on direct blood agar plates. Sometimes it appeared to be present in almost pure culture and sometimes mixed with banal aerobic organisms. Anaerobic surface counts carried out on samples of suspected meat in three different outbreaks were as follows : 125,000, 4,000,000 and 45,000,000 per g. of meat. These counts must be regarded as approximate, because of the large sampling error. The history of the particular meat was nearly always the same. On arrival at the house, or at the school or factory canteen, the meat—which was usually either steak, minced meat or a joint of salt beef—was boiled or stewed and then allowed to cool slowly overnight in the kitchen, usually covered with a cloth. It was eaten at the following mid-day meal either warmed up, re-cooked in pasties or pies, or sliced and served cold, or with hot gravy. When received for examination, the meat varied in appearance and smell. Some samples appeared normal ; others, such as minced meat, were bubbling vigorously and smelt sour.

The rate of attack appears to be fairly high. From 70 to 100% of stool samples from patients have been positive for heat-resistant *Cl. welchii* ; one batch of rectal swabs, however, gave only 50% of positive results. So far, from control groups of normal persons and of those suffering from food-poisoning not of this type, heat-resistant *Cl. welchii* has been isolated from only 4% of about 100 specimens. This proportion is lower than that described for carriers of *Cl. welchii* Type F among the normal population of Hamburg (Hain, 1949). Monkeys artificially fed with these strains of *Cl. welchii* are more or less unaffected, though the organisms can be recovered from the stools for several days. Human volunteers exhibit similar symptoms to those already described, after the same incubation period.

The reservoir of this organism is not yet clear, nor do we know whether the organism is present in the meat when it arrives at the canteen. Persistent carriers are known to exist among kitchen staff ; in one instance a cook continued to excrete the organism in her stools for some months. Work on the toxin and enzyme production of this group of organisms carried out by C. L. Oakley (personal communication) at the Wellcome Research Laboratories has shown that, though strains isolated from food and faeces in any one outbreak may form a homogeneous group, those from a series of outbreaks are heterogeneous.

It is probable that *Cl. welchii* has been responsible for many outbreaks of food-poisoning in the past and that its presence in the food or in the patient's stools has been regarded as of little or no significance. There is no doubt that the present practice in food kitchens of cooking meat and gravy in large containers, and allowing them to cool down slowly overnight before serving the food the next day, favours the occurrence of this type of food-poisoning.

Other organisms recently proved by epidemiological evidence and human volunteer experiment to have caused food-poisoning are the α-haemolytic streptococci described by Moore (1948), enterococci described by Buchbinder and his colleagues (Buchbinder, Osler & Steffen, 1948 ; Osler, Buchbinder & Steffen, 1948), a certain strain of paracolon bacillus (Hobbs, Thomas & Taylor, 1949) and aerobic spore-bearing bacilli (Hauge, 1950).

There may be many other organisms which, when allowed to grow under favourable conditions in suitable foods, may form toxins capable of giving rise to symptoms of gastro-enteritis. It is hoped that future work will gradually lead to their definition.

3. Vehicles of Infection

An attempt has recently been made to compile figures on the types of food proved or suspected to be vehicles of infection (Public Health Laboratory Service, 1950). In 109 out of 191 outbreaks occurring between 1941 and 1948, meat was mentioned ; in 90 of these 109 outbreaks, the meat had been made up, manipulated, or processed in the form of pies, pressed beef, brawn, ham or sausages. In 10 outbreaks, made-up fish dishes were quoted ; freshly cooked fish was not mentioned. Twenty-five outbreaks were associated with puddings and other sweet dishes, 14 with milk, both fresh and tinned, 12 with eggs, both fresh and dried ; and a miscellaneous group including soups, stews, etc. was responsible for the remaining 21 outbreaks.

The success or failure of a food-poisoning investigation may depend on the results of the examination of the suspected foodstuff in the laboratory. This in turn depends on the speed with which the sanitary inspector can reach the scene of the outbreak so as to recover the last scrap of left-over food ; successful results may even be obtained from dustbin samples. The choice of samples may be the entire responsibility of the

sanitary inspector, and it is appreciated by the laboratory when the samples of food brought along are those which are suitable for bacterial growth. Information about the methods used in cooking and serving these foods, and the conditions under which the staff are working in the kitchen, are invaluable, together with other details, such as symptoms, incubation period, and number of persons affected and at risk.

As an independent investigation the rate of growth of pathogens, particularly staphylococci and salmonellae, in various foodstuffs under different conditions is being studied.

4. The Food Hygiene Laboratory

A Food Hygiene Unit was established in the Central Laboratory of the Public Health Laboratory Service early in 1947 and, with the growing concern about the steady rise in figures for food-poisoning, its functions became many and varied.

The central core of routine work is the maintenance of standards for the cleanliness and safety of milk, and the bacteriological control of water, ice-cream, imported spray-dried egg, frozen whole eggs, and many other foodstuffs. When the bacteriological results from any particular article of food, for example ice-cream, are continually below standard, an examination of the plant and of samples taken at each stage of the manufacturing process will often lead to the detection of remediable faults.

The investigation of outbreaks of food-poisoning, particularly those of unknown and doubtful etiology, is carried on in conjunction with local public health departments and the investigation of foods suspected of having caused food-poisoning is undertaken for other units of the Public Health Laboratory Service in conjunction with local public health departments and the Ministry of Health. The laboratory is used in both consultative and practical capacities by the Ministry of Food on matters concerned with the safety of food supplies.

The general need for enlightenment of those usually responsible for food contamination has led to co-operation with the Central Council for Health Education in the production of film strips, charts and other demonstration material, and in the preparation of lectures suitable for courses of instruction in food hygiene. With the encouragement of local authorities, talks have been given to sanitary inspectors, food-traders, and food-handlers of various organizations ; and, in addition, teaching material designed to illustrate the paths of spread of food-borne infection and means of controlling them is sent out at the request of medical officers of health, sanitary inspectors, and directors of the public health laboratories.

5. Kitchen Hygiene

Field work in the kitchens of school and factory canteens, restaurants, and cafés was undertaken to find out whether the prevailing conditions, particularly with regard to methods of washing-up, were such that foodstuffs could easily become contaminated (Hobbs & Kluth, 1950). It was noted that many kitchens, such as those attached to school canteens, were catering for double or even treble the number of persons for which they were originally designed and that in consequence they were overcrowded or understaffed, and also short of equipment. In general, there was too little space allotted to refrigeration, so that left-over foods and meat dishes cooked one day and intended to be eaten cold or warmed up the next day were frequently left to cool overnight in the kitchen at atmospheric temperature, a highly suitable culture medium thus being provided for the growth of sporing anaerobic organisms of the genus *Clostridium*.

Washing-up methods were usually poor except in newly built school canteens where thermostatically-controlled sterilizing rinse sinks were installed. The introduction of many new detergents to replace soap—formerly in such short supply—has eased the task of dish-washing. A few bactericidal detergents are available, but their use should be limited to establishments possessing one sink only and with no facilities for rinsing in really hot water.

Knox & Walker (1947) showed that high bacterial counts were common in large food containers washed without special precautions, whereas, if the containers were sterilized by steam and drained and were not wiped with a cloth, the count was reduced almost to zero. Crockery and cutlery subjected to a final hot rinse of approximately 82° C. yielded lower bacterial counts than any other method of washing dishes (Higgins & Hobbs, 1950). It was shown in the same paper that washing-waters and lukewarm rinsing-waters often contained large numbers of faecal coli, and that most drying-cloths were heavily infected. Boycott (1945) also showed clearly that the kitchen drying-cloth might be responsible for the contamination of plates. Faulds (1948), investigating the hygiene of catering establishments, showed that the bacteriological condition of washing- and rinsing-waters was most unsatisfactory. Hutchinson (1947), in a survey of communal feeding centres, found the cleaning of eating utensils to be unsatisfactory and a possible source of infection. She isolated pathogenic organisms such as haemolytic streptococci, *Staphylococcus pyogenes*, and *Shigella sonnei* from washed utensils, and suggested that these organisms were likely to be spread among the users of these articles and to give rise to sporadic cases.

Frisby (1950) failed to rid teak sinks of faecal coli by means of washing down with soda solutions ; he reported good results for sinks and utensils washed with detergent-hypochlorite solutions. Calcium alginate wool swabs soluble in sodium hexametaphosphate solution were found to be of value for taking counts on washed crockery and utensils (Higgins, 1950).

This is not the place to give detailed reference to the mass of American literature which indicates clearly that partial sterilization of eating and drinking utensils by rinsing in waters from 77 to 82° C. is the safest way to protect the public from the unhygienic and potentially dangerous results of haphazard and casual washing of dishes.

6. Conclusions

The absence of knowledge, among those who design kitchens and their equipment as well as among those who handle food, about the causes, reservoirs, and vehicles of infection of food-borne illness is one of the greatest predisposing factors in food-poisoning. To know the reason behind the constant entreaty for clean hands and refrigeration would surely help those who design kitchens and those who must work in them to a better understanding of the urgency of the appeal.

When an outbreak of food-poisoning has occurred, the sooner the investigators can reach the scene the greater will be

the chances of finding the cause. The co-operation of those working in the kitchen is essential, particularly if accurate details are to be obtained of the preparation of relevant foods eaten during the last 24–30 hours before the outbreak and of a history of any ailments among the staff. If those who are collecting material have a clear picture of the type of food which may be suspected, it will save the laboratory from wasting much time through working with unsuitable specimens. In the laboratory the direct microscopic appearance of the food and a plate count, as well as the direct search for pathogenic organisms, give valuable information on the condition of foodstuffs on arrival. It is essential that the results of typing of such organisms as staphylococci and salmonellae be known before investigations among the staff can be carried out.

Finally, local authorities need more power to correct the faults in structure and equipment which are often apparent in kitchens, and which predispose to the contamination of food prepared in them. The Food and Drugs Act, 1938, began the attempt to improve standards of cleanliness for food preparation and service ; the Model Bye-Laws (Ministry of Food, 1949) suggest further improvements and prepare the way for more detailed codes of practice at present under consideration by the Ministry of Food.

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THE APPROACH TO THE STUDY OF AIR-BORNE INFECTIONS

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1 Descriptive epidemiology
2 Mechanism of dissemination of microbes
3 Application of special techniques to the study of epidemics
4 Laboratory investigations of methods of control of airborne infection
5 Field trials of control methods
6 Conclusion
References

The number of diseases generally regarded as being transmitted from person to person by the air has varied considerably during the seventy years that have elapsed since bacteriology was first enlisted in the support of epidemiology ; but at present we may include, with varying degrees of assurance, diseases in the following three groups : (i) the common infective diseases, such as measles, chickenpox, smallpox, influenza, pertussis, meningococcal meningitis, and others less common ; (ii) inflammatory diseases primarily of the respiratory tract, such as streptococcal sore throat and scarlet fever, the common cold, and pneumonia ; (iii) respiratory tuberculosis. For each of these diseases there are of course special problems, but running as a thread through the study of all three groups is the idea that the infective agent is carried from person to person by the air ; or, put more accurately, there is an absence of any evidence that transmission is by any more tangible route, such as water or food.

It is perhaps worth emphasizing that although the textbook accounts speak glibly of " air-borne infection ", " droplet spread " and the like, the evidence on which such statements are based is of quite a different, and far lower, order of precision from that which supports, for example, a statement that typhoid fever is " water-borne ". As a consequence, partly of a long-held view of the unimportance of the aerial transmission of disease, partly of the technical difficulties of isolating many of the responsible microbes, and partly of the intrinsic complexity of the mechanism of aerial transmission, our factual knowledge in the field is extremely scanty. Nevertheless, the control of the supposedly air-borne diseases is of great importance ; and our problem is to discover, for each disease, sufficient of its natural history to enable us to decide on the appropriate control measures, be they the recognition and neutralization of all human sources of infection, the blocking (as by aerial disinfection) of the channels of spread from person to person, or the artificial immunization of all susceptible persons.

Clearly these are problems that involve a number of fields of study, and the elucidation of the air-borne infections must necessarily depend on the co-operation of bacteriologists in routine departments and in specialized laboratories, both with clinicians and clinical epidemiologists in the Public Health Services and elsewhere, and with laboratory workers having experience in physics or physical chemistry. It may be said directly that only in preliminary studies does the Air Hygiene Unit of the Public Health Laboratory Service work alone ; the more extensive work referred to here has been carried out under the aegis of the Medical Research Council Air Hygiene Committee, and in close collaboration principally with Dr O. M. Lidwell (of the Medical Research Council Environmental Hygiene Research Unit), the Department of Medical Statistics at the London School of Hygiene and Tropical Medicine, or with various units of the Public Health Laboratory Service.

The approach that we envisage to the study of air-borne infections comprises :

i. Precise description, in clinical, epidemiological, and bacteriological terms, of the epidemic and endemic spread of each of the diseases to be investigated.

ii. Laboratory studies of the mechanism of dissemination of microbes, preferably pathogenic, from infected persons ; of their transmission through the air, persistence in dust, etc. ; and, where possible, of their mode of entry into a new host. These studies must be followed by laboratory and field investigations of methods by which the actual or potential dissemination of pathogens can be recognized in normal communities, and by which the relative importance of various methods of transfer may be gauged.

iii. Application of the techniques of (ii) in field studies of communities in which particular diseases are known to occur.

iv. Laboratory investigation of methods by which aerial transmission of infection may be reduced.

v. Experimental application to normal communities of one or more methods thought likely to reduce the spread of infection, and clinical and bacteriological observation of their effects. These trials are designed, firstly, to estimate the importance of the particular route or routes of transmission affected by the method used and, secondly, to indicate practicable methods of prophylaxis for more general use.

Some of these points may be clarified by examples from the work at present being carried out.

1. Descriptive Epidemiology

A general description of the epidemiological work of the Service is given elsewhere in this symposium[1], and here it need only be said that, for a proper description of the bacteriological events, we shall almost certainly need very soon to lean more heavily than in the past on some of the special techniques mentioned in the next section. As an example, in the investigation of outbreaks of streptococcal infection we commonly need to decide which of a number of carriers of the epidemic type of streptococcus might be responsible for the spread of the disease. The work of Hamburger and his colleagues on " dangerous carriers " has emphasized the varying extent to which different carriers disperse streptococci (see, for example, Lemon, 1947) ; and we have therefore attempted to measure this factor in a number of carriers during the investigation both of normal communities and of those in which streptococcal disease was occurring. It would seem that the concept of the " dangerous " carrier, that is, the carrier who is particularly apt to disperse microbes, is one that may well be extended to diseases caused by other agents ; technical methods for estimating dispersal by carriers are worth much further study.

[1] Cook & Payne, p. 185.

2. Mechanism of Dissemination of Microbes

It will serve to clarify the purpose of the current work discussed in the section 3 below if the principal ideas on the mechanism of spread of infection are briefly reviewed (see also Williams, 1948). Infective material may be disseminated from the mouth and throat during talking, coughing, sneezing and so forth ; and in such actions very large numbers of droplets of varying size are formed. It is convenient, though arbitrary, to distinguish as " droplet nuclei " those which, after expulsion, evaporate to particles that are sufficiently small to float in the air. Infection transmitted by such droplet nuclei may be termed " direct air-borne spread ", and may be contrasted with that transmitted over the short range of the larger droplets that are unable to remain air-borne, which may be called " direct droplet spread ".

Infective material from the mouth, nose, and any infective skin lesion also contaminates clothing, bed clothes, floor dust, and other objects of the environment. From some of these, especially clothing and floors, the microbes may be secondarily dispersed into the air and again spread to new hosts ; this may be called " indirect air-borne spread ". Microbes may also be transferred from one host to another by direct or indirect contact with infected fomites without ever becoming air-borne ; this mode of transmission must be taken note of along with the air-borne routes in considering the spread of the " air-borne " diseases.

In tracing the spread of infection we need to have methods for recognizing potential or actual spread of the microbes by one or other of these routes. The " slit-sampler " devised by Bourdillon, Lidwell & Thomas (1941) is a very efficient instrument for collecting bacteria from the air, and it enables us to make some estimate of the extent to which the air of a room is being polluted from the respiratory tracts of the occupants, and from sources of contaminated dust. Thus, in occupied schoolrooms we have shown that the numbers of an organism typical of the normal mouth—*Str. salivarius*—are correlated with the amount of talking among the children ; while the general bacterial count—representing largely microbes from clothing and floor dust—is correlated with the amount of physical activity (Williams & Hirch, 1949, and unpublished work). We may regard such counts as " indicators " of the potential risk of transfer of disease if one or other of these sources happens to be infective.

It is important to recognize that a high bacterial count in the air can be regarded in two ways. Numerous mouth streptococci in the air of a schoolroom represent numerous droplet nuclei, and wherever the streptococci spread there also may droplet nuclei containing pathogenic bacteria or viruses spread ; that is, the air at the point of sampling may be regarded as potentially infective. But, alternatively, the high count may mean that someone in the environment is dispersing large numbers of large and small droplets, and the people near to him may have been infected by the larger droplets which would never have travelled to the air-sampler. This interpretation is clearly only of significance when it is pathogenic microbes that are being counted, for a high count of indicator organisms, reflecting an undue amount of coughing or sneezing, hardly tells us more than could be obtained by direct observation.

From the demonstration that the presence of particular " indicator " organisms in the air is attributable to some particular form of activity, we have clearly to proceed to a search for pathogenic microbes in the air, and to an attempt to correlate their presence both with the number and the state of the potential dispersers and with the attack rate on the susceptible persons exposed in the environment. This step is beset with great difficulties.

The difficulties arise firstly from the fact that, so far as can be seen, the numbers of pathogenic bacteria to be found in the air, even during epidemic times, is extremely small, and in consequence highly selective isolation and cultural techniques have to be used ; secondly, it is certain that the dispersal of the pathogenic bacteria into any particular environment is a rare event, and hence it is difficult to provide the sampling equipment at the right place and time ; and thirdly there are considerable technical difficulties in the cultivation of practically all the pathogenic microbes concerned. With the exception of *Str. pyogenes* and *Staph. aureus* the search for pathogenic bacteria and viruses in the air of normally occupied places has hardly been attempted. Nevertheless, techniques are being studied, and with one of our experimental methods the Virus Reference Laboratory has recently been able to collect variola virus from the air of an isolation hospital housing smallpox patients.

3. Application of Special Techniques to the Study of Epidemics

There is, as we have seen, no difficulty in finding methods for estimating the degree of respiratory pollution of a room ; and it may even be possible to count the number of pathogen-containing particles in the air. But the significance of any such counts is by no means clear, and this constitutes one of the main problems on which work is proceeding. The problem can be approached in two ways. In the first place we can make counts of pathogenic or of non-pathogenic " indicator " organisms in the air of occupied places for which adequate sickness records are available and, with numerous provisos, can attempt to correlate the bacterial counts with the sickness experience of the occupants.

We have employed this statistical approach in a number of field investigations in schools, offices, and factories, and the results are now being analyzed. But it must be recognized that the conclusions can never, from the nature of the approach, be completely satisfactory, and another approach should theoretically be much sounder. If we could define more precisely the mechanism of spread of each disease, we should then be in a far better position to assess the relevance of particular indicator counts. If, for example, measles could be shown to be spread by the direct air-borne route, and never by the indirect air-borne route, we might have greater confidence in regarding an index of persistent respiratory pollution of the air as important. If the spread of whooping cough could be shown to require the close contact implied by direct droplet infection, we should know that the same index was of less importance in assessing the risk of transfer of the disease in a room.

4. Laboratory Investigations of Methods of Control of Airborne Infection

The war-time work of a number of investigators in Britain and America demonstrated that it is possible to reduce the bacterial content of the air of normally occupied places by the use of chemical vapours or ultra-violet irradiation. There

is clearly scope for a great deal more work to discover the best chemical substances for such use, and the best conditions of use ; and there is also a field for further development of methods for rendering handkerchiefs and clothing self-disinfecting along the lines indicated by Dumbell & Lovelock (1949). Research work is being continued in both these fields.

5. Field Trials of Control Methods

One possible way of determining the importance of a particular route of spread of a disease in any given environment would be to block that route and observe the effect on the pattern of disease. For example, aerial disinfection by ultra-violet irradiation of the upper air of a room may be expected to reduce the spread of infected droplet nuclei ; hence, a reduction in the spread of a particular disease in rooms irradiated in this way would indicate that spread by droplet nuclei had some importance in the transmission of that disease.

We regard it as most important to use a reduction in sickness as the measure of the effectiveness of any control. At present we have insufficient knowledge to allow the use of a reduction in the bacterial count of the air as a criterion of the usefulness of an aerial disinfectant ; but by making bacterial counts during the experiment we may hope to show that the disinfectant is able at least to reduce this count, and also to demonstrate the presence or absence of the correlation between the bacterial count and the incidence of sickness. We have so far taken part in one such trial—of ultra-violet irradiation in schools—and have been able to demonstrate a noteworthy reduction in the number of mouth streptococci in the air of the irradiated rooms. We may presume, therefore, that the irradiation killed many of the pathogenic bacteria present in the air in droplet nuclei. Analyses now in progress will show whether this has affected the incidence of any disease.

6. Conclusion

It will be clear that the scope of the investigations envisaged is extremely wide, and it is to be emphasized once more that each of the different diseases needs to be studied individually. Moreover, it may well be that the various modes of spread of infection are of different importance in different environments. The droplet-nucleus or direct air-borne route is perhaps of first importance in the spread of chickenpox in a hospital ward where the children are all in bed ; but it may be of negligible importance in a day-nursery where there are ample opportunities for spread by methods which require the crowding together of infectious persons and susceptible hosts, e.g. short-range large droplet, or true contact, spread. This distinction must be made if we are to give the proper advice on prophylactic measures.

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DIAGNOSIS OF VIRUS DISEASES

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1 Principles of laboratory investigation
2 Variola, vaccinia, cow-pox
3 Respiratory infections
4 Infectious diseases
5 Conclusion
References

The very large amount of basic research on viruses which has been going on during the past twenty-five years has begun to bear fruit in the form of laboratory aid to the clinician in the diagnosis of virus diseases. Although in most virus infections the patient is either dead or recovered by the time the results of laboratory tests are available, the information is of value as an aid to the control and prevention of spread of the infection, and to further knowledge of the epidemiology and interpretation of the effects of chemotherapeutic substances in the treatment of certain diseases.

Some of the tissues of the body, particularly in the central nervous system and the lungs, are comparatively restricted in the manner in which they can react to an infective process ; thus, infections with several different agents may produce the same clinical picture, e.g., aseptic meningitis, encephalitis, atypical pneumonia, or influenza-like illnesses. Although the season of the year, environment, or some other factor may give a clue to etiology, the final answer must frequently come from the laboratory.

1. Principles of Laboratory Investigation

The basic principles of investigation of the etiology of suspected virus diseases are the same as those pertaining to most bacterial, spirochaetal, protozoal or fungus infections, i.e., microscopical examination, culture of the causative organism, and serological tests for antibodies. However, the small size of most of the viruses and their requirement of living cells for cultivation necessitates a slightly different approach to the problem from that applied in the laboratory investigation of other infective diseases. Some diseases may be investigated with the aid of a microscope, a supply of developing chick embryos, and facilities for complement-fixation tests ; but others, such as those in which one suspects a hitherto unknown virus, require the use of a variety of laboratory animals ranging from suckling mice to chimpanzees. These animals are an expensive item and, because of the number of latent infections which they may harbour, this type of work can provide many difficulties, particularly for the uninitiated.

In a country the size of England, a central virus diagnostic laboratory situated in London has a number of advantages. In the first place, material from patients or animals as well as fomites, etc. which have been collected for attempted virus isolation must be transported rapidly to the virus laboratory, and rapid transit is greatly facilitated by the fact that London is the rail centre of the country. Secondly, as in the other reference laboratories, the virus laboratory acts as a co-ordinating centre for numerous investigations and information from different parts of the country, and works in co-operation with medical officers of health, other laboratories of the Public Health Laboratory Service and hospitals, and virus workers in medical schools and other centres, medical and veterinary.

In the early years, much time was spent instructing those unfamiliar with the necessary procedures in what specimens to collect, how to collect them, and on the temperature for storage and transport. One of the essential factors for the satisfactory and successful laboratory diagnosis of virus diseases is the collection of the most suitable specimens and their transport to the laboratory under the correct conditions. All specimens for virus isolation should, on removal from the body, be placed at a temperature of 4° C. or preferably lower, and sent packed in ice or carbon dioxide snow (dry ice), to the laboratory. The possible exception is material from suspected smallpox patients, which will probably survive for 48 hours, at least at temperatures up to 25° C. (Virus in crusts will survive for longer periods but no data are available on the survival period of virus in the " free " state.) Portions of the central nervous system from fatal cases of suspected neurotropic infections may be placed in 50% glycerol and saline solution and kept at 4° C. For antibody estimations, 5–10 ml. of blood should be collected with a clean, dry, sterile syringe and needle, and placed in a clean, sterile container. The serum should be separated from the clot within 24 hours ; clotted blood should not be sent by post unless facilities for separation of serum are unavailable. Sera may be sent by post for journeys of 24 hours in temperatures up to 30° C. For longer journeys, in tropical and subtropical climates, sera should be sent packed in ice whenever possible, especially when derived from patients with infections of the central nervous system. (See Table I.)

There are no specific routine laboratory tests for the diagnosis of the following virus diseases : measles, rubella, infective hepatitis, poliomyelitis, varicella and herpes zoster. A positive Paul-Bunnell test is considered to be diagnostic for glandular fever, a presumed virus disease, but the significance of a negative result in a typical clinical case is debatable. The virus of measles has been cultured in the developing chick embryo, but it produces no distinctive lesions, and proof of growth is obtained only by the inoculation of monkeys or man. The viruses of varicella and herpes zoster may be seen by microscopic examination of vesicular fluid, and intranuclear inclusions may be found in sections of the skin lesions. For special studies, vesicular fluid may also be used as an antigen in the complement-fixation test with convalescent serum. Neither fowl embryos nor animals have been found regularly susceptible to these viruses. The virus causing classical poliomyelitis is pathogenic only for primates on first isolation. There is no routine serological test for all strains of the poliomyelitis virus (see section 4), but in abortive non-paralytic cases a presumptive diagnosis may receive support from the elimination of other possible causes by serological tests for such viruses as those of mumps and lymphocytic choriomeningitis, or for *Leptospira*. Evidence has been obtained that the virus of infective hepatitis can probably multiply in the developing chick embryo, but no distinctive

TABLE I. SPECIMENS FOR VIRUS ISOLATION OR SERUM TESTS

Type of specimen	Quantity and method of collection
Garglings	as in influenza, usually in 10–15 ml. saline to which 2–3 ml. nutrient broth are added after collection
Sputum	½ oz. to 1 oz.[1]
Nose and throat swabs	usually one of each from each side of nose or throat
Cerebrospinal fluid	at least 5–10 ml.
Brain and spinal cord	pieces 1–2 cm. square placed in sterile bottles with rubber bung or screw cap. If available, 50% neutral buffered glycerol or 50% glycerol-saline should be added
Blood	(1) 5–10 ml. in citrate for virus isolation (2) 5–10 ml. in clean dry bottle for serum. Serum should be removed within 24 hours and before despatch by post
Stools	15–25 g.
Bubo pus	up to ½ oz.
Fluid from vesicles or pustules	in capillary tubing ; larger amounts in a bottle with a screw cap or, if very little, should be collected on a throat swab

[1 oz. = 28 g.—ED.]

lesions are produced and the presence of the virus can be detected only by the inoculation of man.

The disease syndromes whose etiology will be discussed in more detail below are those of the pox group, influenza-like illness and the pneumonias, and infective diseases including aseptic meningitis, poliomyelitis-like illness and encephalitis.

2. Variola, Vaccinia, Cow-Pox

The laboratory diagnosis of variola and vaccinia is now a well-recognized and reliable procedure in the hands of virus workers, and can be of considerable help to the health officer and physician, particularly in mild and doubtful cases. It is the one virus disease in which a presumptive diagnosis may always be made within 72 hours (and in the acute stage even within a few hours) of receipt of material in the laboratory. Formerly, tests were usually not made until the vesicular or pustular stage had been reached, but in recent years it has been recognized that smears of scrapings of macules or papules, on well-cleaned glass slides and carefully stained, will reveal large numbers of virus particles which are visible with the ordinary microscope. The next most rapid test is complement-fixation, using the scrapings of material from macules or papules, vesicular or pustular fluid, or tops of active or healing lesions (crusts, seeds), as antigen with a high-titre vaccinia rabbit serum. This test will distinguish variola and vaccinia on the one hand, from varicella, zoster and herpes simplex on the other, but not variola from vaccinia. It takes 16–18 hours to complete. It has been found that in a case of smallpox of moderate severity there is probably sufficient (virus) antigen in three thick smears of scrapings taken from macules or papules to give a positive result in the complement-fixation test, so that it is possible to make a diagnosis of variola or vaccinia before the vesicular stage. Egg culture is the most sensitive method, and also permits differentiation of variola from vaccinia and cow-pox by the appearance of the lesions on the chorio-allantoic membrane, but a period of incubation up to 72 hours may be necessary in order to make a satisfactory interpretation of this test, whether positive or negative. Even if there are only two or three suspected lesions a scraping of these will almost certainly contain sufficient variola virus to provide growth on the egg membrane. As variola virus is said to be present until the last crust has disappeared, the culture test may be used even in cases seen at a very late stage.

These techniques have been used to study the distribution of the virus in patients and in their environment. Detailed studies have been carried out on only a small number of cases, but it is interesting to note that the virus has not been recovered from the nose or throat before the appearance of the rash, and then only when ulcerated lesions were present in the mouth or pharynx. As the virus in the scabs or crusts is protected from the action of disinfectants, it is obvious that it can survive long periods in this state. Virus has recently been found on the bed sheet of one patient, and in the floor dust in the rooms of this patient and of another, both of whom were in the vesicular-pustular stage of variola. These results support the contention that air-borne infection from dust particles would be possible to those who were in close proximity to smallpox hospitals, as was originally contended by Power and others in the 19th century (Power, 1882).

3. Respiratory Infections

A large number of viruses and rickettsiae may cause influenza-like illness and pneumonia, the etiology of which can be determined only by laboratory tests.

Up to 1946 in Australia, and 1947 in Britain and the USA and elsewhere, all strains of the two known influenza viruses A and B appeared to be sufficiently closely related as to hold out hope for satisfactory prophylaxis with standard stock vaccines. The appearance of a new variant of A against which the available vaccines gave no protection turned attention to the need for more extensive and co-ordinated studies throughout the world. The new variant was first recognized in Australia, and then apparently spread east to the USA and west to Europe and Britain. Thus, if new strains can be recognized early in one area, they can be incorporated in vaccines, pending their appearance elsewhere. This work is being co-ordinated by the World Health Influenza Centre at the National Institute for Medical Research, Mill Hill, London, and by co-operating centres in the USA.

Influenza viruses may be isolated from throat-washings in the first 48 hours of illness in about 50 per cent of patients, and specific antibodies may be detected in convalescent serum by the complement-fixation and haemagglutinin-inhibition tests. These antibodies may appear as early as the 5th or 6th day of illness and persist for a year or more in low titre so that, in order to identify a particular case, it is essential to collect serum at the onset, and again at the 12th to 14th day or later, and demonstrate a fourfold increase of antibodies in the second specimen.

Some virus and rickettsial agents may produce a clinical syndrome known at present as primary atypical pneumonia. This is characterized by fever, headache, a non-productive

cough, and malaise more severe than that expected from the detectable physical signs of disease in the chest. An *x* ray of the lung will usually show a pneumonitis of varying extent spreading from the hilum. This may proceed to frank pneumonia. A small proportion of these cases may be due to viruses of the psittacosis-lymphogranuloma group ; more rarely they are caused by lymphocytic choriomeningitis or other viruses and, in some regions of the world, by *Rickettsia burneti* ; all of these agents may be detected by the complement-fixation or other serological tests. However, in the majority of clinical cases, none of these agents can be incriminated. About 50 per cent of this majority develop antibodies in their sera which agglutinate human O erythrocytes at 4° C. or agglutinate a particular non-haemolytic streptococcus, *Streptococcus* M.G. The presence of these agglutinins is closely related to the severity of the illness. A virus isolated by Eaton and his colleagues in California is thought by them to be the cause of most of these infections, and they call their agent the atypical pneumonia virus (Eaton, Meiklejohn & van Herick, 1944). Others use the term primary atypical pneumonia only for those cases which have cold agglutinins or *Streptococcus* M.G. agglutinins in their sera.

In 1948 the Virus Reference Laboratory started a routine investigation of sera from respiratory infections, carrying out the influenza tests there and sending certain of the sera for tests for psittacosis-lymphogranuloma venereum to Professor Bedson, who has for many years been working on this subject at The London Hospital, and for Q fever (*R. burneti*) to Dr Stoker of the Department of Pathology at Cambridge University (Bedson, 1937 ; Stoker, 1949). The number of patients investigated was small at first and, apart from cases of influenza, there were revealed only two patients with suggestive evidence of Q fever in the past. Meanwhile Stoker had obtained serological evidence of recent infection with *R. burneti* in three patients in two different areas of England. In July 1949, the laboratory was asked to examine material from two cases of severe atypical pneumonia suspected by a London physician as being Q fever ; this was confirmed. The rickettsia was isolated for the first time in England at Colindale (MacCallum, Marmion & Stoker, 1949). The staff of the virus laboratory with the co-operation of Dr Stoker, members of the Public Health Laboratory Service, and Veterinary Officers of the Ministry of Agriculture and Fisheries, carried out studies of the conditions and environment of these and related patients which led to the discovery of infection in cows and man in two separate parts of England (Marmion & Stoker, 1950). The effect of various types of pasteurization on infected milk is being tested by the laboratory. The reporting of these cases resulted in a great influx of sera for testing from all over England. Up to the present time serological evidence of human infections has been found in seven counties, all in the southern half of England. More intensive investigations of the local epidemiology are being carried out in a small number of foci of endemicity. The Ministry of Agriculture has begun surveys of cattle sera and bulk milk for evidence of infection with *R. burneti.*

From late 1949, all sera from respiratory infections were tested also for antibodies to the psittacosis-lymphogranuloma venereum group of viruses. In six months this had revealed nine cases of infection with agents of this group, and the absence of known contact with psittacine birds suggests that these patients have contracted their infection from pigeons, chickens, turkeys or some other source ; this disease is for the present referred to as ornithosis. None of these patients was seen early enough in the illness for the virus to be recovered from blood or sputum. The specific causative agents and the sources of infection are being investigated. The Virus Laboratory has confirmed the observation of Andrewes & Mills (1943) on the presence of ornithosis virus in pigeons in England.

All members of the psittacosis-lymphogranuloma venereum group of viruses, of atypical pneumonia of undetermined etiology, and *R. burneti*, are said to be susceptible to the action of aureomycin and, to a less extent, of chloramphenicol. The laboratory, by confirming the specific etiology in the patients concerned, is assisting clinical groups of workers who are carrying out supervised controlled tests of these antibiotics.

4. Infectious Diseases

Aseptic Meningitis

This clinical syndrome, which is characterized by the acute onset of a febrile illness with symptoms and signs of meningeal irritation and a lymphocytic pleocytosis in the cerebrospinal fluid, which is bacteriologically sterile, may occur in a large number of virus infections without other distinguishing features, and frequently can only be identified by laboratory tests, e.g. in lymphocytic choriomeningitis, mumps, poliomyelitis, lymphogranuloma venereum, herpes, glandular fever, etc. With the introduction of streptomycin for treatment of suspected tuberculous meningitis on admission to hospital, the tubercle bacillus may never be isolated and, if recovery takes place without sequelae, the specificity of the diagnosis remains in question as the clinical picture in this disease may be similar to that seen in aseptic meningitis caused by viruses. It is of interest that, in the first 18 months' investigation at Colindale of 102 cases of aseptic meningitis, five were found to be tuberculous in origin after specimens had been sent to the virus laboratory, though tubercle bacilli were said to have been ruled out as a cause. In the second 18 months, only one such incident occurred among 130 patients investigated. Leptospirae, particularly *L. canicola*, may cause a similar clinical picture without obvious evidence of leptospirosis, and were responsible for 10 cases investigated in 1949. The disease may be treated by chloromycetin, and the source of infection, usually a household dog, may be dealt with to prevent further cases.

The virus of lymphocytic choriomeningitis has been found responsible for 3–5 % of cases investigated by the virus laboratory in the past three years (MacCallum, 1949). This virus maintains itself in nature as a latent infection of mice, and man only becomes infected occasionally from food or dust contaminated with mouse excreta in the home. Hence, in our experience, housewives seem to be the most frequent sufferers. Cross-infection in man occurs rarely, if ever. Investigations of the incidence of infection in man and mice in different areas of Great Britain are being carried out.

Mumps virus has been incriminated not infrequently in cases of undifferentiated aseptic meningitis in the USA and in Scandinavia, but in our experience, when this virus has been detected by laboratory tests, there has always been a history of contact with a sibling, or a transient parotitis or orchitis noticed by parent or doctor.

The Coxsackie viruses recently described by Dalldorf & Sickles (1948), and others, have now also to be considered as etiological agents in this syndrome.

When all these agents have been ruled out as possible causes we find that about 85–90 % of cases from which material is sent to us for testing remain undiagnosed. Most of these tend to occur in the period May to October and we consider that they are probably mild infections with poliomyelitis viruses.

Poliomyelitis

At present there is no specific routine laboratory test for the diagnosis of infection with the poliomyelitis viruses. Primates are the only susceptible experimental animals suitable for first isolation of the virus directly from the pharynx, stools, central nervous system, sewage, flies or other suspected materials.

There appear to be at least three immunologically distinct types, but most strains tested fall into two of these. Strains of one of these latter two are characterized by their ability to infect cotton-rats and Swiss mice after primary isolation in monkeys, e.g. the Lansing strain. This property permits tests for neutralizing antibodies in human sera to be carried out. However, these antibodies appear very early in the illness and persist for long periods of time so that, unless one can demonstrate a rising titre, positive results are of no significance. Negative results, of course, indicate only absence of the single immunological type. In this neutralization test, mice must be kept 21 days before assessing the result, so that its use is confined to epidemiological studies. The virus does not multiply sufficiently in either monkey or rodent brains to provide a suitable complement-fixing antigen. The virus has not been detected in the cerebrospinal fluid and rarely in the blood. When isolation of virus is required, the best source is from stools up to two weeks after the onset of illness. In fatal cases, the virus may be recovered from the stools or the central nervous system. If death occurs more than a few days after the onset of paralysis, the stools may be the better source, but the sections of brain and cord should be examined histologically to confirm the diagnosis.

Owing to lack of personnel and facilities, the Virus Reference Laboratory has not yet undertaken large-scale experiments on poliomyelitis. However, there are several practical problems on which information may be obtained by a more modest investigation. It is recognized that the poliomyelitis viruses may attack parts of the central nervous system other than the anterior horn cells of the cord. If the mid-brain is affected, it may produce symptoms and signs similar to those of the disease encephalitis lethargica. Since no specific etiological agent was ever isolated from patients with acute encephalitis lethargica, and sporadic cases are still being notified, it is desirable to examine the stools in the acute stage of the disease for the presence of poliomyelitis or other viruses. In a recent outbreak confined to families in four attached dwellings in a village in England, there were a number of children with an illness diagnosed as acute encephalitis lethargica (all with spastic paraplegia) by a competent physician. There was no case of typical poliomyelitis with flaccid paralysis in the group. One child died after an acute encephalitis of 48 to 72 hours' duration. At this laboratory, a poliomyelitis virus was isolated in monkeys by inoculation of stools from patients in two of the houses, and the fatal case from a third house had lesions in the brain and cord similar to those found in poliomyelitis. The laboratory is testing stools from other cases of encephalitis in children and adults in other parts of England. It is, of course, essential to isolate strains of virus from typical cases in different parts of the country each year for future classification and study.

There has recently been a suggestion that poliomyelitis has occurred in the inoculated limb (usually the arm) in children who received a prophylactic inoculation within the previous month. In some instances, the paralysis has been confined to the inoculated limb, but in others it has become generalized after onset in this limb. The presence of poliomyelitis virus is being investigated in these cases and the strains isolated are being used for experimental studies of the possible factors concerned.

Encephalitis

The only known arthropod-borne encephalitis in Great Britain at the present time is louping-ill, a disease of sheep in which the tick *Ixodes ricinus* is the vector (MacLeod & Gordon, 1932). Infection of laboratory workers with this virus has been recognized in the past, and more recently shepherds (Davison, Neubauer & Hurst, 1948) and abattoir workers (Lawson, Manderson & Hurst, 1949) have been found to be affected. Infection probably occurs also in an inapparent form or as a pyrexia of unexplained origin, and this is being further investigated. Clinically, the disease appears to be confined to sheep in areas of south-east Scotland and the northern border counties of England and Scotland, but as the Ixodid ticks are widely distributed in other parts of England, tests for antibodies in serum may reveal a more widespread distribution of the virus. Although evidence of infection with other members of the arthropod-borne encephalitis viruses has not been found in Great Britain, the possibility of their introduction by air or sea is recognized, and serological and virus isolation studies are carried out on cases of doubtful origin.

Herpes Simplex

This virus can be readily cultivated on the scarified cornea of the rabbit or on the chorio-allantoic membrane of the developing chick embryo, and complement-fixation and neutralization tests can be carried out on patients' sera. There is no vaccine for prophylaxis or specific treatment of recurring infection. Infection with this virus in an eczematous infant may cause severe illness. The virus may also be responsible for aseptic meningitis or, rarely, fatal encephalitis.

Mumps

This virus can be isolated in the chick embryo (Habel, 1945) and tests carried out for serum antibody (Enders & Cohen, 1942 ; Levens & Enders, 1945). Clinical infection is easily recognized except in certain cases of aseptic meningitis without parotitis. The techniques now available may be applied for more accurate confirmation of the incubation period and the duration of infectivity.

5. Conclusion

It can be seen that the laboratory diagnosis of virus diseases has reached a stage where it can be of considerable value in the control of infectious diseases. Most of the tests cannot yet be handled in a routine bacteriological or pathological laboratory, but the centralization of this work, particularly in its early stages, is probably an advantage in any country.

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STANDARDIZATION OF SEROLOGICAL REAGENTS

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1 Dreyer's standard agglutinable suspensions
2 Discovery of H and O agglutination
3 Thermolability of O agglutinins
4 Standardization of Vi agglutination
5 Present method of standardizing reagents
6 Standard sera for international use
References

The value of almost every in vitro immunity reaction depends not only on the specificity of the reaction itself but also on the use of standardized reagents to enable the observer to measure its intensity and to give values which are reproducible by other workers.

The agglutination test is one of the commonest and most important immunity reactions employed in public health bacteriology and, even though it is a simple antigen-antibody reaction, the intensity of the observed reaction could only be given absolute measurable values if the constant dose of bacterial suspension employed throughout the range of serum dilutions represented known amounts of reacting antigen. This is not yet feasible, but it is possible to give an arbitrary standard value to one of the two main reagents, provided it is reasonably stable, so that truly comparable results can be obtained by a number of observers working in different laboratories at different times.

It is one of the functions of the Standards Laboratory for Serological Reagents to prepare standardized agglutinable suspensions for the serological diagnosis of certain infectious diseases, the most important of which are the enteric group of infections. These reagents are issued to all units of the Public Health Laboratory Service and to almost every other medical bacteriological laboratory in Great Britain, and to very many laboratories in countries overseas. This article gives a brief account of the development of the methods employed for the standardization of this material.

1. Dreyer's Standard Agglutinable Suspensions

When agglutination was first discovered by Gruber & Durham (1896) it was related merely to the phenomenon of the flocculation of bacteria. Almost at the same time Grünbaum (1896) and Widal (1896) made similar and independent observations on the clumping or agglutination of typhoid bacilli by the serum of a patient suffering from typhoid fever. These original observations were followed almost immediately by an attempt to give the reaction some measurable value. A technique was devised in which serial dilutions of the patient's serum in saline were prepared on cover-slips and mixed with a living 18-hour-old culture of typhoid bacilli as hanging-drop preparations. After a fixed interval of time at room temperature, microscopic observations were made to see whether or not the bacilli were clumped in a particular serum dilution.

With the introduction of the macroscopical tube method, certain variables, such as temperature and time of reaction, volume of serum-antigen mixture and accuracy of dilution, became more exactly controlled, but there was no control over the varying agglutinability of different suspensions of the cultures used in the test, although the existence of this factor was recognized (Dreyer, 1906). During the period 1915–17 Dreyer and his co-workers (Dreyer, Walker & Gibson, 1915; Dreyer & Walker, 1916; Dreyer & Inman, 1917) developed a method for the preparation of a standard agglutinable suspension for use with a very exacting technique for carrying out the test itself, whereby the variable factors in the reaction could be controlled. It was shortly after this that the laboratory now known as the Standards Laboratory for Serological Reagents was founded.

Its first task was to devise a method for preparing a suitable agglutinable suspension of typhoid bacilli, killed and preserved in formalin, with an opacity representing a fixed number of organisms per millilitre. Then followed the setting up of an arbitrary degree of visible bacterial flocculation of the suspension by a typhoid serum to be accepted as "standard agglutination". There were various degrees above and below this standard so that by means of suitably constructed tables it was possible to express the degree of agglutination with unknown sera in "standard agglutination units". Furthermore, once the agglutinability of the original suspension was fixed, new batches could be prepared and titrated against the original standard and any deviation in agglutinability could be corrected by means of a factor. The agglutinable suspensions, when first prepared, might require a short period to enable the agglutinability to become stabilized, but after this, if kept under suitable conditions, they retained their sensitivity to agglutination in full for very long periods, to be measured in years.

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2. Discovery of H and O Agglutination

Although Smith & Reagh (1903) had drawn attention to the different types of agglutination obtained with suspensions of the normal hog-cholera bacillus and its non-motile variant, the true significance of the large-flaking and small-flaking agglutination in this fundamental observation was not fully appreciated, and the phenomenon remained for many years unnoticed, until it was re-discovered by Weil & Felix (1917) in the course of their work on the H and O variants of the *Proteus* X strains. These observations were soon extended to the typhoid-paratyphoid group of organisms (Weil & Felix, 1920), and led to the introduction of the so-called qualitative method for the serological diagnosis of the enteric fevers; this method is now generally used and is based on the separate estimation of H and O agglutinins for each of the members of the typhoid-paratyphoid group (Felix, 1924, 1930).

Dreyer's standard agglutinable suspensions were essentially concerned in the measurement of H agglutinins and, because of the stability of the final products, their employment with the exact technique laid down for the performance of the test for the estimation of H agglutinins in human sera seemed to justify their designation as standardized agglutinable suspensions. Tubes were prepared to show the degree of flocculation to be accepted as standard agglutination and were issued by the Standards Laboratory. Thus the " standard titre " was defined as the " highest dilution of serum, which, tested against the standard suspension, produces the same degree of agglutination as that shown by the ' Standard Agglutination Tube ' " (Felix & Gardner, 1937). By the employment of the standard H suspensions, the " standard H agglutination tube ", and the Dreyer technique, it was possible for a number of observers examining the same sera to obtain results which agreed fairly closely in so far as the H factor was concerned, although the result of trials made on an international basis proved somewhat disappointing (Gardner, 1937).

3. Thermolability of O Agglutinins

When this standardization technique was applied to O agglutination (Gardner, 1929) the results were not satisfactory. In the first place, agreement by a number of observers as to the end point of agglutination by the Dreyer technique was not so close. The end point reading itself was more difficult and the " standard O agglutination tube " less satisfactory as a standard. In addition, the small-flaking masses formed more slowly so that longer incubation was required before the results of O agglutination could be read. There was a further complication which was not thoroughly understood at the time when O agglutination for serological diagnosis of enteric fever was first introduced—the thermolability of O agglutinins.

In 1917 Weil & Felix had shown that the O agglutinins of *Proteus* X19 were more susceptible to high temperatures than the H agglutinins. This thermolability of *Proteus* OX agglutinins was confirmed by others but it was not until the more complete experiments of Felix & Olitzki (1929) had been made that this thermolability of O agglutinins was fully appreciated. It was clear from this work that the temperature of 55–56° C., originally advised by Dreyer for the incubation of the H agglutination test, could not be applied to the O agglutination test, with its 18 hours' incubation, without the danger of low titre sera losing their O agglutinins. It was decided to reduce the temperature for the test to 52° C. and, in a report to the League of Nations (Felix & Gardner, 1937), pending the development of a more satisfactory method of standardizing bacterial antigens, it was agreed that the method of standardization should follow the lines indicated above.

In applying Felix & Olitzki's experimental observations the present writer, during the years 1937–38, made a long series of observations (unpublished) on O agglutinations in clinical cases of mite and murine typhus and bacteriologically proved cases of enteric fever, carried out at different temperatures by different techniques. He found that in a high proportion of sera (with titres less than 1/1000 when examined at 37° C.) the O agglutinins were significantly reduced in the test carried out at 52° C. This was especially noticeable with *Proteus* OX agglutinations, employing the alcohol-treated suspensions as recommended by Bridges (1935), during the first few days of the disease when a raised titre is so suggestive. It was frequently noted that titres up to 1/300 were obtained with the test carried out at 37° C. though no agglutination whatever was visible in tests done at 52° C. Similar but less obvious differences were found with the enteric group sera.

The method of choice for the accurate titration of O antibodies seemed to be that described by Felix (1930) with the exception that, after incubation for 2 hours at 37° C., the racks of tubes were placed in the refrigerator at 4° C., for 22 hours, owing to variations in room temperature (Bensted, 1940). Felix, Rainsford & Stokes (1941) again drew special attention to the thermolability of typhoid O agglutinins.

It therefore became more and more evident that standardization of the O antigen, carried out by matching the agglutinability of one suspension against a previous standard at 52° C., might lead to less consistent results in routine serum tests than the use of a carefully titrated serum as a standard for the assessment of agglutinability. All standardization tests would require to be carried out at 37° C. and so long as the degree of agglutinability could be set by the standard serum, comparison with other suspensions in parallel would enable the assessment of agglutinability to be made with considerable accuracy.

4. Standardization of Vi Agglutination

It had been suggested by Felix & Gardner (1937) that the most reliable method of standardization of agglutinable suspensions would be one based on the adoption of corresponding agglutinating sera, which could be dried and preserved in the manner known from the standardization of therapeutic immune sera. This principle had, however, not yet been systematically applied to H and O agglutination tests. On the other hand, a " provisional standard serum for Vi agglutination " was prepared by Felix as long ago as 1939 and distributed by him for use in the estimation of Vi agglutinin in the serum of typhoid patients and carriers. This serum is based on the " dried standard anti-typhoid serum " described by Felix (1938), which is held in custody by the Department of Biological Standards, National Institute for Medical Research, Mill Hill, London. The standardized Vi antigen suspension is made from Bhatnagar's strain of *Salm. typhi* (T. Vi I), which is peculiarly suitable for the estimation of the Vi antibody (Bhatnagar, 1938). This antigen is, however, difficult to prepare and is relatively unstable ; nevertheless it has been issued by the Standards Laboratory for more than ten years. It was not possible to have a standard antigen that could be guaranteed to retain its original agglutinability

for comparison with another batch of antigen, and it was at once obvious that the agglutinability could be controlled only by the use of a standardized serum. Not only was it necessary to standardize every fresh batch of Vi antigen by means of this serum, it was also necessary, because of the instability of the prepared antigen, to include the standard serum in every batch of sera to be tested for Vi antibody. The standardization of Vi antigen therefore demanded a fundamental change from the methods devised by Dreyer.

It was found that pure Vi antisera, untreated in any way, retained to the full their original titre over a period of many years. This fact permitted an exact standardization of batch after batch of bacterial antigen, and the issue of the provisional standard serum to certain central laboratories in other countries enabled workers in every part of the world to obtain reproducible results. So long as any particular Vi antigen showed agglutination with the standard serum at its advertised titre, in accordance with the narrow limits of acceptance, then it could be employed as a "standard antigen" for the estimation of Vi-titres in test sera. Outside these limits it was not suitable for issue.

This principle has now been extended to all bacterial antigens prepared for agglutination tests by the Standards Laboratory for Serological Reagents. It has necessitated the preparation of a special series of provisional standard sera which are used solely for the standardization of agglutinable suspensions issued for the serological diagnosis of the enteric group of diseases and other infections.

5. Present Method of Standardizing Reagents

The main changes in the principles now controlling the preparation of standard bacterial antigens for agglutination are first, that the suspension of the particular type of antigen shall be sensitive only to its homologous antibody when employed by the recommended technique, even if other antibodies are present in the serum to be tested, and second, that the degree of sensitivity of that suspension to its own antibody shall be acceptable as a standard reagent only if it reacts with the standard serum within the narrow limits set when its potency was originally estimated.

This has required little fundamental change in the preparation of the H suspensions, which remain formolized broth cultures with a bacterial content of about 500×10^6 per ml. As previously, H suspensions are prepared from colonially smooth cultures of motile organisms which are highly sensitive to H, and relatively insensitive to O, antibody. The standard H sera have been prepared from similarly selected cultures. H suspensions are to be regarded as relatively stable preparations for they generally retain their original agglutinability for two years or more.

All O sera and suspensions, whether of motile organisms, non-motile variants, or normally non-motile bacteria (including dysentery and brucella organisms), are prepared in essentially the same manner. Careful colonial selection from chosen strains, previously shown to contain the full complement of the accepted O antigen factors to ensure the perfect smoothness on a standard medium, is the first essential. Thick suspensions of the culture grown on solid media are suitably treated when necessary to remove the flagella and to get rid of unwanted debris, and the bacterial cells are finally suspended in buffered formol-saline to constitute the pure O agglutinable suspension, having a bacterial content of $8{,}000 \times 10^6$ organisms per ml.

The preparation of the typhoid Vi suspension and serum are special problems, owing to the instability of the Vi antigen. Different Vi strains are used for the antigen and the serum. This is no place for a detailed description of the preparation, which is both tedious and exacting, of the Vi antigen; it can be made suitably only from the strain Vi I in batches of relatively small size, and consequently preparation has to be repeated at frequent intervals. As indicated above, the standardization of this reagent is a continuous necessity from the date of its preparation throughout its life, which may be only a few weeks or, at best, a few months. The moment it fails to react in accordance with the advertised titre of the standard serum it must be discarded in favour of a new batch of the correct sensitivity.

6. Standard Sera for International Use

Recently, it was proposed that the world control of the agglutinability of bacterial suspensions used for the serological diagnosis of enteric fever should be by the issue of standard sera from an international centre (Felix, 1950b). This proposal has now been accepted in principle by the Expert Committee on Biological Standards of the World Health Organization.

The Central Enteric Reference Laboratory and the Standards Laboratory for Serological Reagents, associated departments of the Central Public Health Laboratory, have jointly undertaken the preparation of the following eight horse antisera: *Salm. typhi* (H); *Salm. typhi* (O); *Salm. typhi* (Vi); *Salm. paratyphi* A (H); *Salm. paratyphi* A (O); *Salm. paratyphi* B (H-specific); *Salm. paratyphi* B (H-non-specific) and *Salm. paratyphi* B (O). Bulk supplies, estimated to suffice for many years, have now been prepared. These are shortly to be ampouled and dried in suitable quantities for issue under the Department of Biological Standards, National Institute for Medical Research, Mill Hill, London.

The Expert Committee recommend that these sera be examined in laboratories in six countries for their suitability as standard preparations. A similar procedure is being followed with regard to antisera against the three *Proteus* X antigens—OX19, OX2, OXK (Felix, 1950a).

As soon as agreement is reached by the Committee it will be possible for any country to prepare locally their agglutinable suspensions and to standardize them by means of these "standard sera", employing the standard technique in parallel with the local technique. Meanwhile, the agglutinable suspensions, standardized in accordance with the technique briefly described here, will continue to be sent to all laboratories wishing to employ them.

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FIELD TRIALS OF PROPHYLACTIC AGENTS

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1 Investigation of a new prophylactic—pertussis vaccine
  a Principles of procedure
  b General organization
  c Procedure in the field
2 Trials of improved prophylactics
  a Gamma globulin in the modification or prevention of measles
  b Trials of an improved diphtheria prophylactic
3 Conclusion
References

One aspect of research in preventive medicine to which the Public Health Laboratory Service has directed its attention is the organization of trials of new and improved prophylactics in the field. The structure of the Service is admirably suited to this purpose. By its close association with the Medical Research Council and the Ministry of Health at the centre, and with medical officers of health in areas served by its laboratories throughout the country, it not only quickly becomes aware of new problems as they arise, but also has the machinery for arranging that comprehensive investigations are carried out simultaneously in a number of areas. It is possible also, through the collaboration of directors of area laboratories and medical officers of health, to ensure that inquiries are carried on in conformity with a central plan and that necessary alterations in the scope and direction of an inquiry are made easily and quickly.

The assessment of the value and safety of a new, or improved, prophylactic agent is a complex task, and field studies constitute only one part of the problem; but field studies are important, for the final test must be the prevention of disease in treated persons. Rapid and sustained progress in the development of immunizing agents can be made only with the collaboration of those with expert knowledge of all features of the problem, and by adequate financial provision for large-scale trials. It is fortunate for the research scientist that the public health services are of a high standard, and that medical officers of health appreciate advice and guidance in research methods. During the past thirty years an intimate association has been built up, through the maternity and child-welfare services and school clinics, between the mothers of young children, and doctors and health visitors in health departments; and parents have come to look to the preventive health services for advice and help in promoting and safeguarding the health of their children. Without this confidence on the part of mothers, it is unlikely that field investigations of new prophylactics for children could be instituted on the extensive basis which is required.

At the Central Public Health Laboratory we have been concerned mainly with the following three inquiries, each of which needed a different method of approach:

i. Field trials of pertussis vaccine—a new prophylactic agent of as yet unproven value.
ii. Field trials of gamma globulin in the prevention or modification of measles in contacts—an improved agent for passive protection.
iii. An assessment of the value of PTAP (purified toxoid, aluminium-phosphate-precipitated)—an improved diphtheria prophylactic.

These have been in progress for some time and illustrate the important point that investigators must be prepared to measure the time spent on field trials in years, and not in weeks or months.

1. Investigation of a New Prophylactic—Pertussis Vaccine

a. Principles of Procedure

The trial of a prophylactic in the field presents many difficulties and it is necessary here to define the general principles underlying the procedure adopted.

(a) Before the substance under test is used on a large scale in the field it must have satisfied accepted criteria for the absence of toxicity, severe reactions, and untoward sequelae, and must have been administered to a number of volunteers without ill effect. There must also be presumptive evidence from animal or volunteer experiments that the prophylactic is likely to be of real value.

(b) Before the main investigation is planned, a small-scale preliminary trial should, if possible, be undertaken; a "pilot" field trial quickly reveals unforeseen difficulties, and often indicates how these may be overcome.

(c) For the main study two similar groups of subjects are required, one to act as a test group and the other as a control group. The two groups must be chosen so that, when considered as groups (and not as individuals within groups) they are alike in all relevant respects, except that one group has been treated and the other has not.

(d) Both groups must be observed over the same period of time and with the same care and intensity. The observers

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should not know which of the subjects are in the test group and which in the control group: the subjects—or their parents—likewise must not know whether they are members of the test or control group.

(e) As far as possible the diagnosis of the disease being studied must be confirmed by objective criteria.

(f) All observers should be aware of the whole plan of the investigation and the nature of the substances being administered. The subjects—or their parents—must, as far as is possible, be given full information about the aims of the investigation and about the presumed effects of the substances to be administered.

(g) Investigations should, if possible, be carried out in a number of widely separated areas simultaneously; in all areas the organization and day-to-day work must conform to a central plan.

(h) The trials should be terminated as soon as satisfactory statistical evidence has been obtained.

The essence of a controlled trial is the establishment of two groups of subjects similar in all relevant respects, except that one group is treated and the other is not. Without entering into detailed discussion on the fallacies which may result from failure to observe this principle rigidly, the point may be illustrated by the experiment of Diehl, Baker & Cowan (1938), who investigated the value of orally administered vaccines in the prevention of the common cold in university students. In this study, capsules containing the vaccine were administered to the treated group and capsules, similar in appearance but containing no vaccine, were administered to the control group; the subjects, and the physicians who observed them when a cold occurred, did not know to which group they had been allocated. The results are represented in Table I, which has been constructed from the original paper.

TABLE I. RESULTS WITH POLYVALENT ORAL VACCINE

Group	Number of subjects who completed the study	Number of colds per subject during previous year	Number of colds per subject during year of study	Average number of days lost per subject	Number of subjects who had no colds during year of study
Treated	363	5.6	1.8	0.8	13
Control	372	5.5	1.7	0.7	14

It is obvious that, had Diehl and his colleagues not built up a control group comparable to the treated group, the results in the treated group might have suggested that the vaccine used did in fact influence the incidence of the common cold.

Many difficulties are encountered in constructing satisfactory control groups in field trials, but most possibilities of error can be overcome by accepting volunteers and then allocating them, by the random sampling method or an equivalent method, to one of the two groups. Even when a method for building up two similar groups of subjects has been found, it is still necessary to ensure that records of their experience should be made during the whole period of the investigation without conscious or unconscious bias. It is difficult for an observer to make a confident assessment of a doubtful case if he knows whether the patient has or has not been treated; in order to be thought absolutely fair there is a tendency for him to allocate a doubtful case in the treated group to the " attacked " and a doubtful case in the control group to the " not attacked "; when the assessor does not know to which category the patient belongs, an opinion can be given without this anxiety. It is also necessary to ensure that the subjects, or their parents, in both groups will retain their interest in the investigation and continue to collaborate with the observers; it is unlikely that this interest will be retained if some of the subjects know they are being kept as controls.

For these reasons, in vaccine trials the control subjects have to be inoculated in the same way as the vaccinated subjects, but the inoculum, although it may resemble the test substance, must be inert.

b. General Organization

As a result of the conflicting reports on the value of whooping cough vaccines, and particularly in view of the adverse report by McFarlan, Topley & Fisher (1945), the Ministry of Health requested the Medical Research Council to undertake an inquiry and to advise whether large-scale vaccination against whooping cough should be encouraged. The Medical Research Council formed a committee which comprised experts on the clinical and epidemiological aspects of the disease, on the methods of preparing and testing antigens in the laboratory, on the commercial production of antigens, on the methods of laboratory diagnosis of infection, and on the statistical planning of field and laboratory investigations. It was the function of the committee to decide on a general plan for the entire project, and to delegate to others the detailed organization of the field and concomitant laboratory studies.

As a first step, certain medical officers of health were invited to collaborate in carrying out the field trials with members of their own staffs, supplemented where necessary with investigators appointed or paid for by the Medical Research Council.

c. Procedure in the Field

In the whooping cough vaccine trials, the general principles discussed above were put into practice as follows:

In each area, a " pertussis team " was appointed: this comprised a part-time medical officer, one health visitor or nurse-investigator for every 500 children, and one full-time or part-time clerk.

A pamphlet was issued to all mothers with children in the required age group—the early trials were confined to children between six months and eighteen months of age—either by post or by the health visitors of the health departments on routine home visits. In the pamphlet it was explained that the trial was to determine whether whooping cough vaccines were of value and that, in order to make it a fair test, only half the children would be inoculated with pertussis vaccine; the others would be given an injection which would have no influence on whooping cough. It was also pointed out that neither the parents nor the doctors giving the injections would know, until the end of the investigation, whether any particular child was in the vaccinated or unvaccinated group, that after inoculation each child would be visited monthly for two years by a nurse-investigator, and that, by taking swabs and a clinical history, efforts would be made to ensure early diagnosis of the disease. Also, letters were sent by the medical officers of health to all practitioners in their areas explaining the scheme, and asking for their co-operation. It says much

for the keenness of mothers of young children and for their trust in the advice of medical officers of health and health visitors that in Oxford, Manchester, Leeds, Tottenham, Wembley, Edmonton, and West Ham nearly 10,000 parents volunteered to have their children inoculated.

As the names of the children whose parents agreed to co-operate were received, they were allocated to the treated or untreated groups by the random sampling method, and clinics were arranged at which three inoculations, at monthly intervals, were given. Some of the children were visited the day after each inoculation to determine the incidence and nature of reactions; if children failed to attend for inoculation they were visited in their homes to find out why.

On completion of the inoculations each child was visited monthly and records were kept of the incidence of all respiratory tract infections. If pertussis was suspected, repeated post-nasal (later pernasal) swabs were taken in an effort to establish a bacteriological diagnosis. In addition, a proportion of the children were bled at intervals after vaccination to measure the level of complement-fixing antibodies and agglutinins. In one investigation, opportunity was taken to assess the value of a skin test as an index of immunity.

Two batches of a British pertussis vaccine, three batches of one American vaccine, and two batches of another American vaccine were used. Some of the children have now been observed for more than two years and some for lesser periods. It is not our intention to discuss results, as these are not yet ready for publication in detail, but certain features of the investigation require to be mentioned:

(a) The method of allocation of volunteer children to the treated and untreated groups resulted in the building up of two groups which were, as far as could be measured, equal in all respects (Table II).

TABLE II. THE SIMILARITY IN CONSTITUTION OF THE VACCINATED AND CONTROL GROUPS IN A REPRESENTATIVE STRICTLY CONTROLLED TRIAL IN THE PERTUSSIS VACCINE INVESTIGATIONS

Group	Number of children who completed 3 inoculations	Average age, in months	Male female ratio	Percentage still breast-fed at 3 months of age	Number of attacks of infectious diseases* other than pertussis during period of study	Average number of children under 14 years of age in the families of children in the trial
Vaccinated	494	11.0	0.9	46	158	1.8
Control	464	10.8	1.0	44	160	1.8
Total	958	10.9		45	318	1.8

* Measles, diphtheria, chickenpox, bronchopneumonia

(b) The whole-hearted collaboration of parents has been maintained over the full period of the investigation. No serious difficulties in the carrying out of the trials were encountered, and in none of the children either in the control or vaccinated groups was the attack of pertussis fatal.

(c) As time elapsed, it became evident that, although all but one of the batches of vaccine used were protecting some of the children from infection, there were considerable variations in potency of different vaccines and there was some evidence of differences in the potency of different batches of vaccine prepared by the same manufacturers; there was no clear evidence that these differences in the results on children could be detected by the laboratory examination and biological testing of the vaccines.

(d) It was found that a most satisfactory test of any vaccine was the result of exposure of vaccinated children to infection in their own homes. It was also noted that the home-contact attack-rate in control children was between 80% and 95% in all trials.

During the winter of 1949–50, therefore, a second series of trials was set up in the areas already mentioned and in Cardiff, Poole, Walthamstow, and Leyton, in order to try to correlate the potency of vaccines when used in the field with that determined by laboratory tests, for it was obvious that until vaccines of known standard potency could be prepared no community-wide programme of pertussis vaccination could be attempted. In these trials there were no strict control groups; all children were vaccinated against pertussis with one of three vaccines which had given different results when submitted to a number of tests in the laboratory. The general plan of the investigation was explained to the parents of participants and, again, the response of parents in the areas concerned was good. During a period of nine months, some 8,000 children were inoculated.

While the second series of trials was being set up, more information was obtained on the results of the strictly controlled trials in the first series, and it became apparent that there were very real differences between the vaccines prepared by different manufacturers, and that one type of vaccine was giving consistently higher protection than the other two. The method of preparation of the effective vaccine differed in certain particulars from the others tested, and a third series of investigations has now been planned. In these new investigations, the effective vaccine is to be used as a standard of comparison for vaccines prepared by exactly the same method by other manufacturers, to determine whether uniformly potent vaccines can be prepared by different manufacturers; at the same time intensive laboratory investigations of the properties of the vaccines continue.

We have discussed these trials in detail as they illustrate the changing phases in the examination of a new antigen, and of the alterations which have to be made as data are collected.

When an antigen of undetermined potency is being studied it is essential that it should be given to a group of persons whose experience can be compared with a similar group of untreated persons. When, however, it has been shown that the antigen is of definite value, we consider that it is unfair and unethical to continue strictly controlled investigations and that all who wish to have the antigen administered should be able to have this done; further progress in these circumstances can be made only by adopting a procedure similar to that outlined above.

We consider that certain findings, e.g. that variations exist between vaccines, and that the laboratory testing of vaccines cannot be correlated with the findings in the field, would not have been demonstrated, except over a long period of time, if we had not used this method of investigation. Further, the field studies allowed the collection of material in large quantity for investigation of the serology of pertussis and of methods of isolating the organism.

We are of the opinion that this investigation has shown that it is practicable to apply the statistical method to field investigations carried out by a number of observers in different areas

and to obtain results which can be uniformly analyzed; the local teams which have been formed for this investigation could be and are being used for other similar inquiries.

2. Trials of Improved Prophylactics

Whereas in the trial of a new prophylactic it was deemed essential to give subjects or their parents full details of the aims and nature of the investigation, this was not considered necessary in the investigation into the value of gamma globulin in the modification and prevention of measles, or in the trial of PTAP; both these substances were of the same nature as prophylactics previously employed, and were merely improvements, or possible improvements, on products the value of which had already been established.

a. Gamma Globulin in the Modification or Prevention of Measles

In 1946, workers at the Lister Institute of Preventive Medicine (Kekwick & Mackay, 1949) developed a method for the fractionation of plasma which differed from that employed by Cohn *et al.* (1944) in that ether was used as a precipitating agent instead of ethanol. A " pilot " trial was carried out in 1947–48 with a crude globulin prepared by this method, and, as the results were encouraging, a large-scale investigation was set up at the instigation of the Gamma Globulin Conference of the Medical Research Council in collaboration with medical officers of health of the boroughs of Middlesex, and the medical officers of health of Manchester, Oxford, Liverpool, Salford and the London County Council. The investigation was carried out in day- and residential-nurseries, and susceptible contacts in these nurseries were inoculated (if their parents consented) within 72 hours of the appearance of the rash in the first case in each nursery. To obtain statistically sound results, the contacts were classified by age and by degree of intimacy of exposure and were divided, by a modification of the random sampling method, into two groups; the members of one group were given globulin and the members of the other group were given adult serum in 5 ml. doses. To ensure that observers would be able to assess the results without fear of bias, the details of the intimacy of exposure and of the inoculum given were made on one part of the record, and this was filed away as soon as inoculations were completed. The children were then observed for 21 days after inoculation. If those in day-nurseries were absent during this period, visits were made to their homes to ascertain the reason for absence and, if measles developed, to assess the severity of the attack. The results of the observations were recorded on a second part of the record which contained no information on the nature of the inoculum; experience had shown that it was impossible for the observer to remember whether any particular child had received globulin or adult serum. This investigation has now been completed and the results have been published (Lancet, 1950).

b. Trials of an Improved Diphtheria Prophylactic

For thirty years up to 1940 some 50,000 cases of diphtheria were notified each year in England and Wales, and some 2,500 of these cases were fatal. In 1940, the Ministry of Health introduced its diphtheria immunization campaign, and diphtheria prophylactics were issued free to medical officers of health and to practitioners. Since 1942 the number of cases and of deaths has fallen steadily and in 1949 only 1,897 cases were notified, and only 85 deaths were reported.

The prophylactic mainly employed during these years was alum-precipitated toxoid (APT). It is clear that this product met the requirements of a good prophylactic, namely that it was capable of reducing the incidence of diphtheria to very small proportions.

Recently Holt (1947) devised an improved prophylactic which he named purified toxoid, aluminium-phosphate-precipitated (PTAP). In a series of investigations Bousfield (1947) and his colleagues showed that PTAP caused less local reaction than APT (which was never wholly satisfactory for older children and adults) and, when injected in a single small dose, gave a consistently higher Schick-conversion rate.

However, before PTAP was made available to all medical officers of health and practitioners the Ministry of Health considered it advisable to obtain information on its use on large numbers of persons. It was clear that the incidence of diphtheria was so low that little information of value would be obtained for some years on the capacity of the new prophylactic to prevent diphtheria in inoculated children, unless its potency was very much less than that of APT.

It was thought, however, that valuable information could be obtained within a short period on Schick-conversion rates and on the presence or absence of untoward reactions. An inquiry was therefore planned on the following lines:

In collaboration with the medical officers of health, the issue of APT was replaced by PTAP in twelve large county boroughs—Bradford, Bristol, Cardiff, Ipswich, Leeds, Leicester, Liverpool, Manchester, Newcastle-on-Tyne, Norwich, Oxford and Southampton—while the remaining authorities continued to use APT. In the chosen areas, arrangements were made for some children and young adults who were primarily immunized, or given reinforcing doses, to be visited 2 days and 14 days after each inoculation to determine the nature and severity of the local and general reactions, and to be Schick-tested three months after inoculation. Thus it is hoped that records of the experience of some thousands of persons inoculated with PTAP will be obtained within a reasonable period of time.

3. Conclusion

In this paper we have discussed the methods used in three field investigations of one new prophylactic and of two improved prophylactics, each investigation requiring a different method of approach. No new techniques of field work have been employed, but we have stressed what we consider to be the important factor in these inquiries, namely, that by the collaboration of laboratory and scientific experts with medical officers of health and their staffs, problems of preventive medicine can be successfully tackled. It is our opinion that the methods developed can be applied to other inquiries of a similar nature and that they should also be used for periodic checks on established methods of prophylaxis.

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EPIDEMIOLOGICAL CONTROL OF INFECTIOUS DISEASES

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1 Some advantages of a unified laboratory service
2 Role of the laboratory in field investigations
  a Streptococcal infections
  b Enteric infections
3 Research work on epidemiological problems
References

In the study of infectious disease in a community, the unit is the individual case and it is necessary to establish the relationship of this case to other cases, to carriers and to contacts. In certain types of infection the fact that two or more cases are related is not always obvious, and the information enabling such a conclusion to be drawn is not always readily available. Sometimes the infection is confined to a semi-isolated community such as a school or other institution, and under these conditions a general picture of the outbreak is obtained from the medical officer in charge. Quite frequently, however, the disease is more widespread and may show itself in one of the following forms:

i. A number of sporadic and apparently isolated cases.
ii. One or more small localized outbreaks in unrelated areas.
iii. A widespread outbreak involving a number of local authority areas or even two or three counties.
iv. Epidemics throughout the country.
v. Pandemics.

Depending on their nature, infections manifesting themselves in the manner indicated under categories i, ii and iii may pass almost unnoticed, although they may be responsible for a considerable amount of sickness, and outbreaks originally confined to small areas may develop into widespread epidemics.

1. Some Advantages of a Unified Laboratory Service

The defences of the country against infectious disease depend primarily on the local health authority, i.e., on the medical officer of health and his assistants. The medical officer's knowledge of the immediate prevalence of infectious disease is confined mainly to his own area, though the Registrar General's weekly return gives the number of notifications of infectious disease in the country as a whole. This arrangement is satisfactory if the disease in question is notifiable and is, in fact, notified. This is the case with some of the more serious infectious diseases; large-scale outbreaks of smallpox and typhoid are quickly recognized, and contacts are rapidly traced. The system fails, however, to give a general picture of the incidence of such diseases as streptococcal infections of the throat, Sonne dysentery, or salmonella infections. In these and certain other infections sporadic cases and small outbreaks are common and, in the absence of a widespread epidemic or of some obvious link between the cases, no epidemiological investigations are made and no general preventive measures taken.

Before the establishment of the Emergency Public Health Laboratory Service there was no machinery available by which a picture of the true incidence of these diseases could be obtained. As described by Dr G. S. Wilson,[1] laboratories belonging to or affiliated to the Service now cover the major part of the country. These laboratories deal with the day-to-day bacteriological specimens from practitioners, and with specimens from outbreaks investigated by the local health authorities; they are therefore particularly well placed for assessing the incidence of many bacterial infections in their area. A weekly summary of their experiences is circulated to the laboratories and all directors are aware of any major incidents in other areas and of the occurrence of single cases of certain diseases. This information is available several days earlier than the Registrar General's weekly return, and is given in greater detail. Copies of reports to practitioners are sent to the medical officer of health concerned and in this way he is also kept informed of the incidence of many infectious diseases which are not notifiable.

In addition to this general picture the regional and reference laboratories are able to obtain a more detailed picture of certain diseases from the information provided with cultures sent for special investigation from laboratories all over the country. The work of the individual reference laboratories is dealt with in other articles in this number of *British Medical Bulletin*. In all major epidemiological investigations by the Service consultation with the appropriate reference laboratory is automatic and often yields information of immediate value.

Regional laboratories may also be in a position to assist the director of an area laboratory in the investigation of a serious or large-scale epidemic. The services of a full-time epidemiologist attached to the regional laboratory may be available for co-operation in the field investigations, and technical assistance or supplies of media can be sent to help in the extra bacteriological work required.

When these facts are considered together with the close liaison that usually obtains between the Public Health Laboratory, the medical officers of health, the practitioners and the local general and fever hospitals, it can be appreciated that the opportunities for studying and controlling infectious disease are unusually great.

2. Role of the Laboratory in Field Investigations

The help of the laboratory may be sought by the medical officer of health, the medical superintendent, or the school medical officer, in outbreaks of infectious disease among the general population, in hospital wards, in children attending day-schools, or in boarders in residential schools or other institutions. Among the more common types of outbreak investigated are scarlet fever and other streptococcal

[1] See p. 147.

infections, diphtheria, typhoid and paratyphoid fever, Sonne and Flexner dysentery, and food-poisoning due to salmonella organisms and staphylococcal or other toxins.

The method of approach in investigating an outbreak is governed by a number of factors such as the nature and extent of the epidemic and the type of community attacked, and the help given by the laboratory will depend largely on the local circumstances of each outbreak. It is not possible to describe a number of investigations in detail, but two examples have been chosen, one of an upper respiratory, and the other of an enteric infection, to illustrate some of the ways in which the Public Health Laboratory Service can co-operate in field investigations.

a. Streptococcal Infections

The Public Health Laboratory Service is frequently consulted in cases of infection due to *Streptococcus pyogenes*. Occasionally the infection may be one of puerperal sepsis, as in the outbreak investigated by Knox & Marmion (1945), but the majority of streptococcal outbreaks are of either scarlet fever or tonsillitis. Children are particularly prone to streptococcal throat infections and a number of outbreaks have been investigated in boarding-schools and other institutions for children (Moore, 1943; Boissard & Fry, 1944; Vollum & Wilson, 1945; Cook & Munro-Ashman, 1949). Scarlet fever and streptococcal tonsillitis in residential communities may prove extremely troublesome to the medical officer of health or school medical officer, and the help of the laboratory may be sought in an effort to bring such outbreaks under control as soon as possible.

In the early stages an attempt can be made to detect heavy carriers among those sections of the community particularly exposed to risk and any such carriers can be segregated and treated. In the later stages of an outbreak, however, the large number of carriers detected usually makes such a policy administratively difficult, if not impossible. In addition, the high degree of environmental contamination—from classrooms, dormitories, clothing, etc.—which has usually taken place by that time lessens the chances of success of any plan aimed solely at the elimination of carriers. An added difficulty in combating streptococcal throat infections among children at day-schools is the risk of cross-infection to which the children are exposed outside school-hours. Infection may be transmitted from one child to another in the home or elsewhere, and in this way may be spread from school to school.

In October 1948 a widespread outbreak of 42 cases of scarlet fever and an unknown number of cases of tonsillitis occurred among 900 children attending three day-schools (A, B, C) in and around Buckingham, and among the general population. When the assistance of the Public Health Laboratory was requested, six cases of scarlet fever had occurred in B, five of which were in one class, and one case in A. The schools were visited and swabs were taken in two affected classes; five heavy nasal carriers of the epidemic type, 5/25/Imp.19, were found at B, but none at A. The epidemic type was also isolated from the dust at B. The patient from A had travelled to school by bus with two of the patients from B and was believed to have been infected there. During the next few days eight further cases of scarlet fever occurred in B and in C, and three cases occurred among the population of neighbouring villages; it was then apparent that the organism was widespread in the area. With the closest co-operation of the medical officer of health and school medical officer, and the health departments of Buckingham borough and Buckingham rural district and the local practitioners, notification was promptly received of all new cases of scarlet fever and swabs were obtained from cases and contacts. It was decided to carry out a fuller investigation of the two schools, B and C, and swabs were taken by the laboratory from all pupils and staff. Numerous samples of dust were also examined. The epidemic type was isolated from 19 pupils at B and 8 at C and from the dust of a number of classrooms at both schools. All nasal carriers were excluded from school and treated at home by sulphonamide insufflation. Both schools were completely cleaned and the floors oiled during the week-end. Two further cases were notified from each school in the next two days, but after that no further cases occurred at C and no fresh cases occurred at B for ten days. In the meantime, however, three cases from A and two more cases among the general public had been notified. Swabs were taken from the pupils and staff of A and five nasal carriers of the epidemic type were discovered. From the dust, a scanty growth was obtained from the canteen only; it is of interest that all floors at this school had been oiled during the holidays two months before. The carriers were excluded and treated, and only three further cases occurred in this school, a few weeks later. Epidemiological inquiries suggested that some of these later cases at B and A were due to cross-infection at home or in the school bus, but unfortunately dust samples from the bus could not be obtained.

Though the main work of the laboratory was the control of infection among the large groups of children in the schools, attempts were also made to ensure that the infection was not re-introduced by spread in the surrounding villages. The co-operation of the local practitioners was particularly valuable since their notification of fresh cases enabled swabs to be taken from contacts who were excluded until known to be free from infection. The sources of these home infections were also sought, and in several instances contact with a case or carrier from one of the schools was established. The degree of contamination of the home environment by carriers or cases was estimated by examination of dust samples, and swabs from other members of the family. It will be appreciated that the examination of more than 2,000 specimens in this outbreak was a major undertaking, especially as all strains were typed. The full bacteriological investigations, and the close co-operation with the local health authorities and the general practitioners, gave a fairly complete picture of this outbreak and made it possible to bring it under control.

b. Enteric Infections

A number of outbreaks of typhoid and paratyphoid fever have been investigated by the Public Health Laboratory Service in co-operation with the local medical officers of health, and in some cases with representatives of the Ministry of Health. Several of these have been large-scale outbreaks (Hogg & Knox, 1942; Marmion, 1946; Wallace & Mackenzie, 1947), and tracing the source of infection and inspecting the contacts has necessitated detailed investigations in the field and the examination of large numbers of specimens of faeces, urine and blood by the laboratories concerned.

The usual type of explosive outbreak quickly draws attention to itself, and the dates of onset of the first wave of cases may give some indication of the place or vehicle of infection

and so enable the investigators to concentrate their attention on a relatively small number of suspects. On other occasions, however, the picture may be one of a series of sporadic cases of infection occurring over quite a large area for a considerable length of time (Felix, 1943; Bradley, 1943; Cruickshank, 1947). It is in this type of outbreak that the routine reports of the laboratories, coupled with Vi-phage typing and supplemented by data accumulated at the Central Enteric Reference Laboratory and Bureau, may reveal a probable linkage between the cases and enable a systematic search for the source of the infection to be made. The following outbreak is of this type and is described more with a view to illustrating the advantages of the organization of the Public Health Laboratory Service than for any light it may throw on the epidemiology of paratyphoid fever.

At the beginning of June 1949 the Director of the Service received reports of the isolation of *Salm. paratyphi B*, Vi-phage Type 3a, from four laboratories in Newcastle, Sunderland, and Carlisle (Kennedy & Payne, 1950). The typing was carried out according to the scheme published by Felix & Callow (1943). About a dozen cases had been recognized, most of them in the urban districts of Jarrow and Hebburn, but also in the urban districts of Washington, Hexham, Bolden, the county borough of Sunderland, the rural district of Easington, and two rural districts near Carlisle. Consultation with the Central Enteric Reference Laboratory and Bureau revealed that in 1947 there had been an outbreak due to the same phage type in the urban districts of Blaydon and Gateshead—areas which adjoin that of Jarrow—and that there had been four sporadic cases in north Durham and south Northumberland since then. As it appeared possible that a widespread outbreak might be imminent, an epidemiologist was sent from a regional laboratory to co-operate in the investigation with the ten separate health departments and four laboratories concerned. Inquiries in the Jarrow-Hebburn area soon showed that contamination of the synthetic-cream filling of cakes made at a local bakery was responsible for the cases in Jarrow, Hebburn, Washington, Bolden and Easington, but not for the cases in Sunderland, Carlisle and Hexham. The source of infection in Sunderland remained obscure. It was found, however, that the Carlisle and Hexham patients had all consumed confectionery made in a bakery situated 24 miles from Carlisle and 13 miles from Hexham, and a visit to the bakery revealed a possible source of infection in one of the employees. This girl was recovering from an illness diagnosed retrospectively on serological grounds as paratyphoid B fever; she was thought to have infected her brother, from whom *Salm. paratyphi B*, Vi-phage Type 3a, was isolated.

In addition to the bacteriological examination of large numbers of specimens and phage-typing of all strains, the role of the Public Health Laboratory Service in this outbreak was to provide a link between ten separate health departments, each being kept fully informed of the state of the outbreak and the progress of investigations in other districts. This knowledge of the general picture saved many useless inquiries in the areas least heavily affected, and enabled the investigators to link up cases 40 miles apart with a hitherto undetected case of infection in a bakery in another area. The medical officer of health had had no previous notification of cases in this area and, being thus made aware of the dangers existing, was able to warn the local practitioners of the possibility of undetected infections.

3. Research Work on Epidemiological Problems

Our knowledge of the methods by which various diseases spread is to a large extent based on epidemiological observation and there are many gaps which can be filled only by research work in the laboratory and in the field. Such work is constantly being carried on alongside the routine investigation of outbreaks, but there is space in this article only briefly to indicate the scope. Two subcommittees are active in directing research on the problems of streptococcal and salmonella infections. These problems are discussed elsewhere in this number. Other important diseases on which work is in progress are poliomyelitis and infantile gastroenteritis, which are briefly considered below. The work of Moore (1948, 1950) has provided another means of tracking down carriers of *Salm. typhi* and *Salm. paratyphi*, and Payne (1949) is studying the role of the hands in the transmission of gastro-intestinal infections. The work of Knox & Macdonald (1943), Hutchinson (1947), Knox & Walker (1947) and Frisby (1950) has contributed to our knowledge of the dangers of faulty hygiene in canteens. McFarlan is following up his earlier work on infective hepatitis (McFarlan, 1945) with a long-term programme of research. Studies on air hygiene (Williams, 1948; Williams, Hirch & Lidwell, 1950), dealt with in another article,[2] have directly contributed to our knowledge of the spread of air-borne infections. Allison & Hobbs (1947) and Williams, Sims-Roberts & Cook (1947) have shown the value of serological and bacteriophage typing in studying the epidemiology of staphylococcal infections, particularly pemphigus. The work of Edward *et al.* (1947) throws light on the problems of cross-infection and " return " cases of scarlet fever.

Poliomyelitis

During the large outbreak of poliomyelitis in 1947, a field survey was planned by the Public Health Laboratory Service at the request of the Ministry of Health. Epidemiological inquiries were set on foot, centred mainly in Oxford and Cambridge, and a special questionnaire was drawn up for this purpose. This was filled up by medical officers of health and others for 911 cases, and some preliminary results have been published (McFarlan, 1949; Cook, 1949). Two regional laboratories undertook the task of distributing and collecting the questionnaires from different parts of the country and worked in close co-operation with the medical officers of health concerned. Field studies are still being continued in an attempt to ascertain any features in common among the individual cases which might advance our knowledge of the methods of spread of this disease. Unfortunately, investigations have had to be confined largely to epidemiological and statistical studies, as the shortage of monkeys has severely curtailed laboratory studies.

Infantile Gastroenteritis

During the war and the immediate post-war period some alarm was occasioned by the number and severity of outbreaks of this disease, and the Public Health Laboratory Service investigated a number of outbreaks from the point of view both of controlling the immediate outbreak and of studying the etiology of the disease and its method of spread. The Service was peculiarly well situated for this work, since it was

[2] See Williams, p. 171.

possible for the same observer to investigate and compare the clinical picture and the epidemiology of outbreaks in widely separated areas, and at the same time to provide the reference laboratories with a flow of fresh material from different sources for bacteriological and virus studies. Some of this work has been published (Cook & Marmion, 1947; Taylor, Powell & Wright, 1949). Taylor and her colleagues were able to confirm independently the work of Bray (1945), Bray & Beavan (1948) and Giles & Sangster (1948), showing that outbreaks of this disease are associated with a high incidence of a specific serological type of *Bact. coli.* The status of this organism in the etiology of the disease is, however, still uncertain, and recently it has been shown that a high incidence is not necessarily followed by an outbreak of the disease (Payne & Cook, 1950).

On epidemiological and clinical grounds, experience gained during these investigations suggests that there are at least two types of infantile gastroenteritis of unknown etiology. One is generally severe with a high mortality and affects only young infants, e.g. the Derby outbreak (Taylor *et al.* 1949), and it is in these that a specific type of *Bact. coli* is found. The other is mild and affects both adults and infants (Cook & Marmion, 1947). It is possible that further types may be defined as our experience grows.

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NATIONAL COLLECTION OF TYPE CULTURES

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1 Development of the National Collection
2 Examination and description of cultures
3 Bacteria maintained in the National Collection
4 International relations
5 Plans and new activities

Culture collections fulfil a long-felt want in serving as museums of cultures and in providing typical strains for reference purposes. Most collections have had a chequered career and some, such as Kral's famous collection in Prague and Vienna, have disappeared and are now no more than a memory. Others, such as the Centraalbureau voor Schimmelcultures at Baarn, Holland, suffered the ravages of war but survived to continue to give good service to laboratory workers. The National Collection of Type Cultures has had its tribulations ; it reached its lowest ebb at the beginning of the Second World War when, evacuated from London into the country, it found itself, with nearly 5,000 cultures to maintain, temporarily housed in one small room. In the years that followed, more laboratory space became available and the cultures, most of which had been dried between 1935 and 1939, were found to have survived well.

After the war a policy of decentralization was introduced and the National Collection restricted its activities to organisms of interest to workers in the fields of human and veterinary medicine. In 1949, to take advantage of the specialist knowledge and experience of workers in the reference laboratories of the Public Health Laboratory Service, the Collection was moved to a new laboratory built for it at Colindale.

1. Development of the National Collection

The nucleus of the National Collection of Type Cultures, which was formed in 1920 by the Medical Research Committee (now Council), was a small collection of cultures maintained in the bacteriology department of the Lister Institute of Preventive Medicine. With the co-operation of the Lister Institute, Dr (later Sir John) Ledingham, its chief bacteriologist, became the first honorary director, and Dr R. St. John-Brooks the first curator. For nearly thirty years the Collection was closely associated with the Lister Institute, which provided laboratory accommodation and services, and from it most of the Collection's staff was recruited.

The cultures taken over from the Lister Institute's private collection were mainly pathogenic species of interest to medical workers. By 1922, when the first edition of the National Collection's catalogue was issued, the number of strains had increased to about 1,200 ; the additions included fungi, yeasts, and bacteria of interest to those working in industry and agriculture, thus broadening the scope of the Collection. Expansion continued steadily. That the Collection fulfilled an obvious need was shown by the increasing number of cultures distributed each year (Table I) ; there was a steady

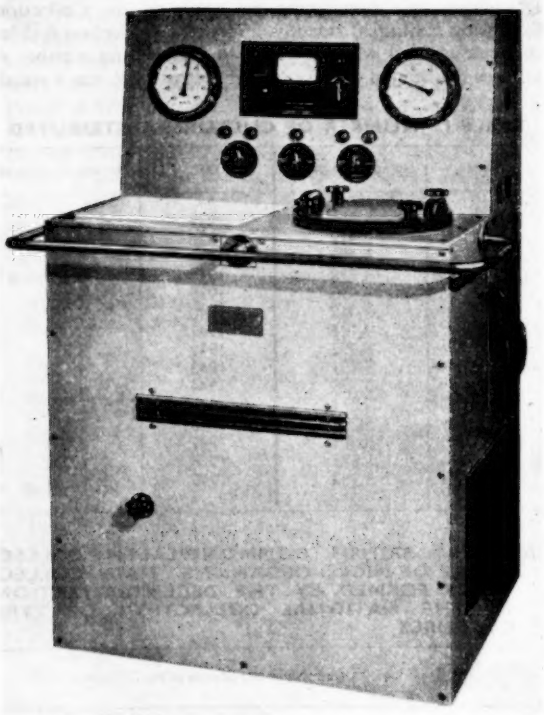
TABLE I. NUMBER OF CULTURES DISTRIBUTED

Year	Number of cultures	Year	Number of cultures
1920	1,850	1935	5,722
1921	2,489	1936	5,723
1922	3,658	1937	6,041
1923	3,828	1938	6,397
1924	4,510	1939	5,687
1925	4,068	1940	3,767
1926	4,196	1941	3,204
1927	4,192	1942	3,921
1928	5,151	1943	4,128
1929	5,175	1944	4,651
1930	5,271	1945	5,771
1931	5,017	1946	7,011
1932	5,508	1947	8,094
1933	5,323	1948	6,056
1934	5,282	1949	6,515

TABLE II. BRITISH COMMONWEALTH COLLECTIONS OF MICRO-ORGANISMS. MAIN COLLECTIONS FORMED BY THE DECENTRALIZATION OF THE NATIONAL COLLECTION OF TYPE CULTURES

Micro-organisms maintained	Name and address of the Collection
Medical and veterinary bacteria	National Collection of Type Cultures, Central Public Health Laboratory, Colindale Avenue, London, N.W. 9
Fungi and yeasts pathogenic to man and animals	Sub-department of Medical Mycology, London School of Hygiene and Tropical Medicine, Keppel Street, Gower Street, London, W.C. 1
Fungi : plant pathogens, industrial fungi	Commonwealth Mycological Institute, Collection of Fungus Cultures, Ferry Lane, Kew, Surrey
Wood-rotting fungi	Forest Products Research Laboratory, Princes Risborough, Aylesbury, Buckinghamshire
Yeasts (non-pathogenic) and brewing organisms	The Institute of Brewing, The Goring Hotel, Grosvenor Gardens, London, S.W. 1
Bacteria pathogenic to plants	Sub-department of Mycology and Plant Pathology, Botany School, Downing Street, Cambridge
Industrial bacteria: bacteria for microbiological assay	National Collection of Industrial Bacteria, Dept. of Scientific and Industrial Research, Chemical Research Laboratory Teddington, Middlesex

FIG. 1. CENTRIFUGAL FREEZE-DRYING APPARATUS



Photograph by W. Edwards & Co. (London) Ltd.

increase until 1939, when the Second World War caused a temporary setback to the Collection's work. After 1945 large numbers of cultures were sent to laboratories in Europe that had lost their own collections during the German occupation.

With the widening interests of the Collection the problems of culture maintenance became more complex ; the addition of fungi and yeasts demanded the introduction of new techniques and new media. If the expansion of the Collection were to continue, and the cultures were to be adequately maintained, only two courses were open : the staff could be increased to include mycologists, plant pathologists, industrial microbiologists, and agricultural bacteriologists ; or the Collection could be decentralized so that each part was maintained by workers specializing in a particular branch. The Council decided on the latter course and arrangements were made to transfer the fungi, yeasts, industrial bacteria, soil bacteria, and plant pathogens to other laboratories. In 1947 the United Kingdom National Committee of the British Commonwealth Collections of Micro-organisms was set up to co-ordinate the work of culture collections in the Commonwealth, and the transferred sections of the National Collection helped to form the new specialized collections in the United Kingdom (Table II).

The National Collection of Type Cultures receives many requests for cultures that it does not now maintain. When these requests come from laboratories abroad the National Collection passes the request to the collection concerned ; in this way time is saved. Although the additional collections may be new in name, many of them have been in existence for several years, and all are staffed by workers expert in dealing with particular groups of micro-organisms. The Commonwealth Collections organization, by encouraging smaller laboratories to make available their more specialized collections, and by publishing directories of culture collections, is rendering a great service to those who want to obtain reliable cultures. The secretariat of the British Commonwealth Collections of Micro-organisms is at the British Commonwealth Scientific Liaison Offices, Africa House, Kingsway, London, W.C. 2.

The National Collection of Type Cultures itself, having been left with a smaller and more homogeneous group of organisms to conserve, was able to take full advantage of modern developments in the maintenance of bacteria. Until 1934, cultures were maintained by subculture at regular intervals, a procedure known to induce changes in the character of micro-organisms, and many strains in the Collection lost their original characters.

In 1934 a simple method of drying cultures was tested and found to be efficient, and between 1935 and 1939 nearly all strains of bacteria in the Collection were dried. The advantages of dried cultures are many ; the organism retains the cultural, serological, and pathogenic characters that it had when it was dried, and, as most bacteria survive for many years, time and media are saved because subcultures are unnecessary. The method used in the Collection was not suitable for the large-scale production of dried cultures, but a few years ago such a method was devised by Dr R. I. N. Greaves of Cambridge. The apparatus needed is now made by a London firm, and up to 400 tubes of culture can be dried at a time ; these small tubes are robust and can be packed easily for transmission through the post. This plant (cf. fig. 1) is now in use in the Collection.

To ensure that the ampoules contain living organisms a count is made of the bacteria in the suspension that is to be dried, and, at intervals after drying, counts are made of the viable bacteria in the ampoules. Not only do these tests show that the dried cultures are viable, but the counts provide evidence of the death-rate of the bacteria and indicate when the cultures should be re-dried.

2. Examination and Description of Cultures

Both before and after drying, each culture is examined by cultural and biochemical tests and the results are recorded on specially printed descriptive cards measuring 32.8 cm. by 15.2 cm., made up into pads of 500 sheets for use in the laboratory. (See fig. 2 for plan of card.)

In the descriptive sections on morphology, colony form, and type of growth in broth, the words that apply are underlined ; in the sections on biochemical tests and fermentation reactions the results of these tests are inserted by the observer. The word " not " is deleted where it is inapplicable as, for example, in " Not acid-fast " when describing a mycobacterium. Completed cards are stored by a modern filing system with visible edges. Much of this descriptive work is carried out in the National Collection, but more specialized tests, such as serological typing, are made by workers in the reference laboratories of the Public Health Laboratory Service, and in other laboratories.

FIG. 2. PLAN OF DESCRIPTIVE CARD USED BY THE NATIONAL COLLECTION OF TYPE CULTURES IN THE EXAMINATION OF CULTURES

Genus & Species		Strain		Cat. No.
MORPHOLOGY		METABOLIC	FERMENTATION	*
CYTOLOGY		BIOCHEMICAL		†
COLONY		BROTH		

Details included in the sections shown above are as follows:

MORPHOLOGY Medium..... T°..... .....d Stain.....

SHAPE Spheres, ovals, rods, filaments, commas, spirals.

SIZE ..... × ..... AXIS Straight, curved.

SIDES Parallel, bulging, concave, irregular.

ENDS Rounded, truncate, concave, pointed.

ARRANGEMENT Singly, pairs, fours, chains, groups, clusters, bundles, cubical packets, Chinese letters.

REGULARITY Monomorphic, pleomorphic. Club, filaments, branched, citron, navicular, fusiform, giants, shadow.

CYTOLOGY Gram..... Not acid-fast. Capsule.....

STAINING Easy, difficult; even, irregular, bipolar, barred, beaded. Easily decolourised. Fat globules, metachromatic granules.

MOTILITY ..... T°..... FLAGELLA Mono-, amphi-, lopho-, peritrichate.

SPORES Spherical, oval; equatorial, sub-, terminal; no, slight, bulging.

CELLS Septate, non-septate; true, false, branching.

NUCLEI ..... per cell. Crossed, paired. SHAPE Rod, dumb-bell, circular.

COLONY Medium..... pH..... T°..... .....d

SIZE .....mm. SHAPE Circular, irregular, radiate, rhizoid, swarming.

ELEVATION Effuse, raised, low convex, domed, umbonate.

SURFACE Smooth, rough; striated, ringed; bread-crumb like; dull, shining.

EDGE Entire, undulate, lobate, crenated, erose, fimbriate, effuse, heaped-up.

COLOUR ..... Fluorescent, iridescent, self-luminous.

OPACITY Transparent, translucent, opaque.

CONSISTENCY Butyrous, viscid, friable, membranous, pick-off-whole.

EMULSIFIABILITY Easy, difficult. SUSPENSIONS Uniform, granular.

VARIATION .....

METABOLIC

Aerobe, fac. anaerobe, microaerophil, anaerobe.

.....% CO_2 favours, required for growth.

T° 22..... 30..... 37.....

pH range..... to..... Optimum.....

Pigment .....

Koser's citrate..... Urea.....

Simmond's citrate..... NH_3 salts.....

BIOCHEMICAL

Final pH in glucose broth..... at.....d.

Indole ..... Eijkman .....

M.R..... V.P. .....

NH_3..... H_2S .....

Nitrates not reduced; nitrites not reduced.

M.B..... Catalase.....

LITMUS MILK acid..... alkaline.....

neutral..... acid clot..... rennet clot.....

litmus decolourised..... digestion.....

GELATIN liquefied .....

Digestion of serum, egg, meat.....

BROTH Medium..... pH..... T°..... .....d

SURFACE GROWTH Absent; ring, pellicle; thin, thick; smooth, rough; disintegrates.

TURBIDITY Absent; slight, moderate, dense; uniform, granular, flocculent.

DEPOSIT Absent; slight, moderate, abundant; powdery, granular, flocculent, viscid.

DISINTEGRATES easily, with difficulty, not at all.

FERMENTATION

Glucose.....	Inulin.....
Arabinose.....	Glycogen.....
Xylose.....	Dextrin.....
Galactose.....	Glycerol.....
Lactose.....	Mannitol.....
Sucrose.....	Dulcitol.....
Maltose.....	Sorbitol.....
Trehalose.....	Inositol.....
Raffinose.....	Salicin.....
Starch.....	Aesculin.....

HYDROLYSIS OF

Starch ..... Urea .....

*

.....blood agar .....haemolysis

Gelatin stab .....

Meat: gas, foul odour; pink, black, crystals

Egg yolk: lecithinase..... filtrate.....

Resistance: survived at..... C. for.....min.

killed at..... C. for.....min.

Special media .....

Acriflavine 1–500.....

ANTIGENIC STRUCTURE.....

PHAGE TYPE.....

PATHOGENICITY.....

†

CULTURE EXAMINED .....

In connexion with the checking and description of organisms in the Collection, a study is being made of different methods of carrying out the routine biochemical tests, and as these are made on a wide variety of bacteria it is hoped that the experience gained will enable standardized methods, giving reproducible results, to be developed. An example of this kind of work will show the complexity of the problem. In a preliminary survey of the tests for acetylmethylcarbinol production, three media were used, cultures were incubated at three different temperatures, and tests were carried out by five methods on seven different days, a total of 315 tests on one culture. It was easy to select the most sensitive method and the best temperature for incubation, but the provisional standard method still requires nine tests, carried out on three media, incubated for three different periods of time.

3. Bacteria Maintained in the National Collection

The term " medical and veterinary interest", when applied to the bacteria maintained in the National Collection, is interpreted liberally ; in addition to the recognized pathogens, the Collection contains representative strains of the non-pathogenic species. Thus in the genus *Bacillus*, with only one species of undoubted pathogenicity, other species have to be distinguished from it, and most of these are kept in the Collection. In some genera, such as *Chromobacterium* and *Leuconostoc*, no known species is pathogenic but these organisms have a medical interest in other properties they possess ; *Chromobacterium* species can be used as tracer organisms, and are of particular value when they are used with media specially designed to encourage pigment production. Strains of *Leuconostoc* species produce dextrans that have been used as plasma substitutes.

Strains are being graded into three categories :

i. Authenticated strains : a small number of very carefully checked strains that are regarded as typical, culturally and serologically, by workers experienced in the identification of these species. As far as possible, strains in this category are freshly isolated, and many are being supplied by the Directors of the Reference laboratories of the Public Health Laboratory Service.

Some strains, such as the *Salmonella* species received from Kauffmann, are well authenticated by the depositor, but, after drying, these are checked in the Salmonella Reference Laboratory to make sure that a variant form has not been selected. Organisms used in the preparation of agglutinable suspensions and in the preparation of diagnostic sera are being supplied by the Standards Laboratory. In these strains the growth phase of the organism is most important ; the Standards Laboratory provides the actual culture that is dried, and subculture in the National Collection is eliminated. After these cultures have been dried, the organisms recovered from the ampoules are checked in the Standards Laboratory. A new set of cultures of the serological types of *Streptococcus pyogenes* is being provided by the Streptococcal Reference Laboratory, and Dr A. W. Stableforth has deposited a set of the serological types of *Streptococcus agalactiae*. In conjunction with the Staphylococcal Reference Laboratory, experiments are being made on the drying of staphylococcal bacteriophages ; so far the results are promising, and it is hoped that it will soon be possible to dry a complete set of stable bacteriophages.

These examples indicate the advantages to a culture collection of being able to work in close association with highly specialized workers ; without their help the National Collection could not offer its small number of authenticated strains, which should be especially valuable to those engaged in teaching, and to workers who are making systematic studies of a particular group of organisms.

ii. Checked strains have been examined by workers in the National Collection ; in general, these strains agree with the published descriptions. In successive transfers, many of them have lost their original characters and these are being replaced by freshly isolated strains as they become available.

iii. Deposited strains are those that were deposited either because the organisms had some special interest, or because the workers could not continue to maintain them in their own laboratories. These strains generally bear the name given to them by the depositor (modified to avoid synonymy) and the National Collection does not accept any responsibility for the correctness of the depositor's identification. The majority of strains in the Collection are in this group and it will be many years before they can all be examined and transferred to the category of checked strains.

The *List of species maintained in the National Collection of Type Cultures* is published by His Majesty's Stationery Office as Medical Research Council Memorandum No. 21 (second edition, 1950), and is obtainable from booksellers in all parts of the world.

4. International Relations

The fullest co-operation exists between the National Collection and collections in other countries, and speedy and constant exchanges of information and cultures can be made by airmail.

About 1,500–2,000 cultures are sent each year to individual workers in hospitals, research institutes, and university departments outside the British Isles. The international aspects of the work are constantly receiving attention, and one of the benefits to be gained from drying cultures for distribution will be a quicker supply of cultures in light-weight containers suitable for airmail packages.

Differences in nomenclature sometimes create difficulty in dealing with correspondents in other countries ; scientific names can usually be resolved but the common names of bacteria are not always clear when translated from one language to another. Correspondents are urged to use scientific names and to give the authority for the name when this is necessary. Problems of taxonomy are being studied in centres set up by the World Health Organization, and by committees set up by the Nomenclature Committee of the International Association of Microbiologists ; the National Collection co-operates in this work by supplying cultures, some of historic interest, to these centres.

5. Plans and New Activities

Plans to improve the distributive work of the Collection are nearing completion ; the number of authenticated cultures is being increased, and stocks of the dried ampoules of these cultures are being built up. It is hoped to start the distribution of dried cultures early in 1951. Recently-isolated strains have begun to be added to replace those discarded because they have become atypical by repeated subculture. Increasing numbers of cultures are being put through a series of standard tests, and the record cards of the Collection should form a valuable aid in drawing up complete descriptions of organisms that have not been adequately described. The experience gained in carrying out the tests should help in the selection of standard methods and the development of new techniques.

A start has been made on the systematic study of the detailed structures inside bacterial cells, and the results may indicate the need for changes in our ideas on bacterial classification. Problems of nomenclature and classification are constantly under review in the National Collection, which is one of the few laboratories devoted entirely to the more academic aspects of the study of bacteria.

SANITARY BACTERIOLOGY

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1 Sewage
2 Water
3 Milk
4 Ice-cream
References

The term " sanitary bacteriology " is commonly used in Great Britain to denote the examination of specimens of non-human or non-animal origin. In this article it will be restricted to the isolation of excretal pathogens from sewage, and to the bacteriological control of the vehicles by which infection from excreta is most commonly transmitted, i.e., water, milk and ice-cream.

1. Sewage

The function of ordinary sewage-works treatment is to produce an effluent that can be discharged into a river or stream without causing a nuisance or rendering the water lethal to fish. It is perhaps not widely enough realized that many effluents which satisfy the standards recommended by the Royal Commission on Sewage Disposal (1913) contain organisms pathogenic to man. The faecal pathogens, which gain access to the crude sewage from enteric and dysentery carriers, and from transient cases in the population, can resist the usual measures taken for purifying sewage, and can remain alive in the effluent and for a considerable distance downstream.

The public health bacteriologist is interested principally in the demonstration of these pathogens in sewage and sewage effluents. The high general bacterial content necessitates the use of the same selective solid and liquid media as are employed for the isolation of pathogens from faeces, e.g. bismuth sulphite agar (W. J. Wilson & Blair, 1927; modified by Tabet, 1938, and Hobbs, 1943), deoxycholate citrate agar (Leifson, 1935; modified by Hynes, 1942), tetrathionate broth (Muller, 1925; Knox, Gell & Pollock, 1942; Rolfe, 1946), selenite F medium (Leifson, 1936), deoxycholate citrate broth (Gell, Hobbs, & Allison, 1945), and the liquid medium of W. J. Wilson & Blair (1931). The low proportion of pathogens to non-pathogens in sewage has made successful isolation more difficult from this source than from faeces, and for a long time the presence of, for example, the enteric organisms in sewage was suspected from indirect evidence only.

In 1928, however, W. J. Wilson demonstrated the presence of typhoid bacilli in sewage, and in the following year Gray isolated paratyphoid B bacilli from similar material (Gray, 1929). Gell, Hobbs & Allison (1945) discovered twelve carriers of typhoid and one carrier of paratyphoid B bacilli in an institution, by examination on selective media of bulked sewage from individual blocks of buildings in the institution. Martin (1947) reported the isolation of *Salm. paratyphi B*, *Salm. typhi-murium*, and *Salm. tennessee* from town sewage and filter effluent by enrichment and subsequent plating on a selective solid medium. In addition, the isolation of paratyphoid B bacilli from a bathing pool, from river water, and from a house drain led to the discovery, by individual stool examination of the eleven persons using the water closet connected to the drain, of two excreters of the organism. In such investigations, however, there had usually been a chain of circumstantial evidence pointing to the existence of an excreter.

An advance of considerable epidemiological interest was reported by King (1944), when a strain of *Salm. paratyphi B* discovered in the filter effluent of a factory was later traced, by stool examination of individual workers, to a single symptomless carrier of the organism.

Moore (1948, 1950), starting from an infected sewage effluent, developed a technique for tracing *Salm. paratyphi B* and *Salm. typhi* from main sewers to tributary sewers, and eventually to the inspection chambers of drains from individual houses. Gauze anchored by string to the manhole cover was immersed in the flowing sewage for 48 hours. Broth washings were then cultivated by direct plating and enrichment. This technique proved extremely sensitive for paratyphoid bacilli, yielding carriers in " almost embarrassing abundance ", and was satisfactory for typhoid bacilli provided bismuth sulphite agar and selenite F were among the media employed.

2. Water

It will be apparent that in water the absence of pathogenic organisms such as the typhoid bacillus cannot be adopted as a standard of purity, on account both of the technical difficulty in isolating such organisms and of the high degree of dilution which sewage may undergo when contaminating a water supply. Instead, a search is made for the common intestinal bacteria, which are used as indicators of excretal pollution.

The principal contribution which bacteriology can make in the assessment of water supplies is therefore the detection of *latent* excretal pollution. Chemical analysis, indispensable for excluding other risks such as the possibility of metallic or saline poisoning, lacks the delicacy of the bacteriological method, and has now been superseded by it for demonstrating the existence of pollution. An essential preliminary to sampling is thorough supervision of the supply, from source to distribution, to exclude any visible risk of pollution or any obvious failure in the purification process. Since, moreover, the examination of a sample can indicate the state of the water only at the time of sampling, and since pollution, if it occurs at all, may be intermittent, samples should be collected at frequent intervals and under varying meteorological conditions. Used in this way bacteriology can become the ultimate safeguard of a supply which on sanitary inspection appears to be satisfactory.

To secure greater uniformity in the bacteriological technique

of different workers throughout this country, the Ministry of Health produced in 1934 a report, which was revised in 1939 (see Ministry of Health, 1939), on the bacteriological examination of water supplies; this encouraged simplification of existing methods to permit the more frequent examination of samples. In the hands of the Public Health Laboratory Service the routine examination has been curtailed to a search for direct evidence of faecal contamination, and consists in the quantitative estimation of the coliform content with particular reference to that most characteristic organism of faeces—*Bact. coli* Type I (faecal coli). This organism is so abundant in faeces that its absence from 100 ml. of a sample of water justifies as reasonable the assumption that faecal pathogens are also absent. If more than minimal numbers of faecal coli are present in 100 ml. of a sample, the existence of significant pollution is indicated and the supply cannot be adjudged safe.

In the course of the examination the presence of coliform bacteria of all types is disclosed, and the exact significance to be placed on those types other than faecal coli remains debatable. Recent investigators (Burke-Gaffney, 1932; Bardsley, 1934; Malcolm, 1938; Parr, 1939; Taylor, 1942) have thrown doubt on the belief that the " non-faecal " coliform bacteria have an innocent origin in soil and vegetation. These organisms have been shown to be frequently present in faeces (Bardsley, 1938a), and often in quite considerable numbers (Taylor, 1942). Their presence without faecal coli in a properly collected sample of water most probably indicates that contamination has occurred but at such a remote stage that faecal coli (and the pathogens, if any) have failed to survive. Such a water would not, at the moment, be dangerous, but the possibility of dangerous pollution at other times would be indicated, and further investigations should follow, with sampling especially after heavy rainfall.

The coliform examination commences, as described in the Ministry's report (see also Thresh, Beale & Suckling, 1949), with the inoculation of various volumes of water into tubes of neutral-red bile-salt lactose peptone water (MacConkey broth). After incubation at 37° C. the tubes are examined for lactose fermentation, as shown by the production of acid and gas. From the number of positive tubes is calculated, by reference to special tables, the probable number of (presumed) coliform bacteria present in 100 ml. of the sample (the " presumptive coliform count "). By plating from each positive tube to MacConkey agar, to determine whether the organism causing the fermentation belongs to the coliform group or not, the true coliform count can be obtained. (The error of the test in this country appears to be very small, certainly under 2%, but individual samples, particularly of chlorinated water, may show a high proportion of spurious results due to sporing anaerobes, such as *Cl. welchii*, which survive storage and chlorination.) In addition, from each positive tube a subculture is made into a fresh tube of MacConkey broth which is incubated at 44° C. Gas production at this temperature is practically specific for faecal coli, and from the number of tubes giving this result is calculated the faecal coli count. From these findings, in conjunction with a knowledge of the source of the sample, the safety or otherwise of the supply is assessed.

Gas production at 44° C. may occasionally be caused by anaerobes or by certain of the Irregular coliform types, notably Irregular VI which appears to flourish in jute imported from the tropics and used for the jointing of pipes. This may explain the difficulties reported in the tropics with the 44° C. test, and in this context it is noteworthy that Irregular VI has been isolated in fair numbers from various surface supplies near the Oldham cotton mills in Lancashire (Watkinson, personal communication, 1950). By inspection of the MacConkey plates most of these fallacies can be discovered, but difficulties arise when the original tube contains a mixture of 44° C.-negative coliform bacteria together with Irregular VI or anaerobes. Mackenzie, Taylor & Gilbert (1948) have elaborated for the 44° C. test a brilliant-green bile lactose broth which inhibits the anaerobes. By running a parallel test for indole production they can distinguish between faecal coli and Irregular VI. This medium would be ideal for the presumptive test, but it requires American ingredients and its use on an extended scale is at present economically impossible in Great Britain.

These are among the problems which are being investigated by a Water Subcommittee of the Public Health Laboratory Service with the aid of Dr E. Windle Taylor of the Metropolitan Water Board Laboratories. This subcommittee has retested the error of the presumptive count, prepared a memorandum for the guidance of samplers, and is at present studying the viability of coliform bacteria in stored samples of water.

The report of the Ministry of Health (1939) proposed certain standards for various types of water supplies. These standards, based on the presumptive coliform counts as ascertained by regular sampling throughout the year, are as follows:

i. *Chlorinated piped supplies*: the presumptive coliform count should be uniformly zero;
ii. *Non-chlorinated piped supplies*: the presumptive count should never be greater than 10 per 100 ml., should be less than 3 in 80%, and less than 1 in 50%, of samples;
iii. *Small rural supplies* (*shallow wells, springs, etc.*): the presumptive count should not be greater than 25 per 100 ml.

There is the added proviso that the presence, in any supply, of more than minimal numbers of faecal coli cannot be safely ignored.

These standards have proved generally satisfactory in practice. With chlorinated waters, however, where the presumptive error is greatest, it would be an improvement if the basis were the true coliform count (cf. the " colony-confirmed " count of the American *Standard methods for the examination of water and sewage*, American Public Health Association, 1946).

3. Milk

When examining milk, the bacteriologist is at a greater disadvantage than when examining water. By routine methods it is impossible to tell whether a given sample of milk is safe to drink, as is possible with water. The most that can be determined is whether the milk is of a reasonable standard of bacterial cleanliness [1].

Since for obvious reasons no exact standards of bacterial cleanliness, applicable equally to all milks examined at any time between production and consumption, can be laid down, the bacteriological approach has been concentrated on four different aspects of the problem: cleanliness in production; the presence and relative numbers of bacteria active in

[1] See also *Brit. med. Bull.* 1947, 5, articles by Smith, J., p. 192; Rowlands, A., p. 196; McClement, J., p. 201; Anderson, E. B., p. 208.

producing tainting or souring; the keeping quality; and, finally, the freedom of the milk from pathogenic organisms, i.e., its safety.

The first three of these may be considered together, as a milk produced under clean conditions will usually be free from taint and less likely to sour soon after production than a milk produced under dirty conditions. The fourth or safety aspect of the milk has no necessary connexion with the first three, since a milk of good keeping quality may yet harbour a variety of pathogenic organisms, and vice versa. G. S. Wilson *et al.* (1935) carried out a comparison of the tests in use for assessing the cleanliness and keeping quality of milk, and described a modified methylene blue reduction test for the routine grading of raw milk; by this test milk could be classified on the basis of cleanliness into any number of grades desirable, and it also afforded, on the whole, a very good index of keeping quality. This methylene blue test at 37° C. later replaced the plate count for the official grading of designated raw milks (Ministry of Health, 1937). A modification of the test (Statutory Rules and Orders, 1946), performed on pasteurized milk at the time of delivery to the consumer, was adopted as an index of the contamination of such milk subsequent to heat treatment or of its exposure to unsatisfactory temperatures. A comparison of the methylene blue reduction test and the "clot-on-boiling" test for keeping quality of milk (Ministry of Agriculture and Fisheries, 1932) is being conducted by laboratories of the Public Health Laboratory Service and of the Ministry of Agriculture and Fisheries.

With regard to the safety of milk, the introduction by Kay & Graham (1935) of the phosphatase test, as a means of assessing the degree of heat treatment a milk had received, went a long way towards ensuring adequate pasteurization of milk. The test, delicate as it is, has one important limitation in that it is unable to detect less than about 0.2 % of raw milk in otherwise adequately pasteurized milk (G. S. Wilson, 1942). For this reason it is desirable, especially in milk pasteurized by the high-temperature short-time process, to supplement the phosphatase test by guinea-pig inoculation.

It must be remembered that the degree of "safety" conferred by the phosphatase test supplemented by guinea-pig inoculation is high only in so far as *Myco. tuberculosis* and *Br. abortus* are concerned. There do not exist routine methods for assessing the freedom of milk from contamination by typhoid, paratyphoid, and dysentery bacilli, haemolytic streptococci, diphtheria bacilli, and possible infections of virus origin. Post-pasteurization contamination of adequately heat-treated milk by these organisms is always a possibility. For example, Thomas *et al.* (1948) traced the origin of widely scattered cases of paratyphoid fever to a single pasteurizing plant, and isolated the organism from the stream water which was used for the final rinsing of the milk bottles.

4. Ice-Cream

As with milk, the most that can be determined by the routine bacteriological testing of ice-cream is whether the product is of a reasonable standard of bacterial cleanliness. There is, however, the added physical difficulty that ice-cream cannot be accurately measured by a pipette. Partly for this reason, the early unofficial attempts to assess the cleanliness of ice-cream by plate counts and coliform tests were subject to gross sampling errors. Moreover, the coliform tests, when carried beyond the presumptive stage, were found to yield less reliable results than with water. Spurious positives caused by aerobic as well as anaerobic spore-bearers were not uncommon. Most coliform organisms proved to be of the non-faecal type, and even some of those that produced gas in MacConkey broth at 44° C. were found on further study to belong to Irregular Type VI.

The lack of a statutory laboratory test having long been deplored, the Service set up in 1946 a subcommittee to investigate the possibility of devising a test which could be used with reasonable accuracy for assessing the cleanliness of ice-cream as sold to the consumer. The sudden post-war expansion of ice-cream production and the occurrence in Aberystwyth, Wales, of a large outbreak of typhoid fever caused by the contamination of ice-cream by a chronic urinary carrier (Evans, 1947), emphasized the urgent need for a cheap, easy and rapid method of control.

Despite the rising incidence of food-poisoning outbreaks in this country, there are few published records incriminating ice-cream. This may be partly owing to the frequent difficulty in tracing vendors and to the consequent uncertainty that ice-cream was the cause. Many patients with gastro-enteritis give a history of having consumed ice-cream in the previous 24–48 hours, but in the summer many people consume ice-cream nearly every day. Three outbreaks of acute staphylococcal food-poisoning in Oxfordshire and Gloucestershire were reported by Williams *et al.* (1946); one outbreak of paratyphoid fever in Coatbridge, Lanarkshire, by Cordiner, in the *Report of the Medical Officer of Health for the years 1946-1949*; one outbreak of salmonella food-poisoning due to *Salm. typhi-murium* in Boston, Lincolnshire, by Chamberlain (personal communication); and one outbreak of salmonella food-poisoning due to *Salm. newport* near Skipton, Yorkshire, by Hunter in the *Annual report of the Medical Officer of Health for the year 1949* (Urban District Council of Skipton). Food-poisoning due to ice-cream is also referred to by Cockburn (1950) in his analysis of food-poisoning in England and Wales in 1949.

Grading of ice-cream in many respects resembles that of milk. Bardsley (1938b) made use of the plate count, coliform count, enterococcus count and the *Cl. welchii* count. The relative merits of the tests for the grading of milk and ice-cream were discussed by G. S. Wilson *et al.* (1935) and G. S. Wilson (1948). The subcommittee, as a result of their investigations and the evidence at their disposal, devised a methylene blue test which has been used for the past four years and has proved a most useful single test for grading ice-cream on the basis of bacterial cleanliness.

As ice-cream is a frozen product, it was found that the methylene blue reduction test as used for milk was unsuitable. A modified test was elaborated and its technique and the results of its use have been published in the subcommittee's four reports (Public Health Laboratory Service, 1947, 1948, 1949, 1950). The test depends on the principle that the methylene blue is reduced as a result of the total metabolic activity of the organisms present, so that the speed of the reduction gives an indication of the bacterial population.

As the test is simple to set up, numerous samples can be examined on one day, or repeat samples can be taken from a single trader. This test has been used on numerous occasions to detect the source of contamination, by taking samples at different stages of production and sale. One disadvantage

has arisen which, however, does not materially upset the grading. Occasionally, thermoduric organisms capable of reducing methylene blue are present, especially *B. cereus*, easily identified by the egg-yolk reaction of McGaughey & Chu (1948). It seems from experience that these bacilli rarely lower the grade of a sample below Grade 2. Their presence can easily be checked by setting up a duplicate methylene blue tube which has been pasteurized at 70° C. for 10 minutes. If the difference between the two reduction times is two hours or less, one may assume that thermoduric organisms are present. They may come from badly cleaned and sterilized equipment, or occasionally from the ingredients, such as dried milk. As aerobic and anaerobic spore-bearing bacteria are liable to give false positive presumptive coliform tests, and are not usually detected, their action in the methylene blue test cannot be regarded as a serious objection to the test; but their presence should be looked for in any doubtful cases. Tables published in the subcommittee's reports show that the use of this test, in conjunction with the Ice-Cream Regulations (Statutory Rules and Orders, 1947), has resulted in a steady improvement in the quality of ice-cream during the past four years.

Objections to the test have not been substantiated. The apparent discrepancy in individual samples between the test and the plate count has been considered by Clayson & Pirie (1948) and Laws (1948), but as the two tests are measuring different qualities it is unreasonable to expect complete agreement between them. So far no chemical substance has been found in ice-cream which can upset the test as recommended.

In examining ice-cream supplies at different stages of production, we have been able to make observations on the common causes of contamination. The laboratory results have frequently been confirmed by personal inspection of the trader's plant and premises. The pasteurization itself is seldom to blame, as long as the required temperature and time have been maintained. Contamination commonly occurs after pasteurization, usually as the result of faulty cleaning and sterilizing of equipment or of faulty cooling, i.e., either delayed cooling or cooling to a temperature which is above the required 45° F. (7.2° C.).

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SURVEY OF FUNGUS DISEASES IN BRITAIN

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1 Dermatophyte infections
2 Superficial infections
3 Aspergillosis
4 Infections by yeast-like organisms
5 Subcutaneous mycoses
6 Systemic mycoses
7 Diagnosis of fungus infections
References

Bacteriologists of the Public Health Laboratory Service are frequently called upon to assist in the diagnosis of mycotic diseases. To co-ordinate their findings, and to arrange practical courses in diagnostic methods, a Mycological Reference Laboratory was established in the Sub-Department of Medical Mycology at the London School of Hygiene and Tropical Medicine. This laboratory now examines about 4,000 specimens each year, and undertakes the preparation and distribution of skin-testing reagents. It has been found expedient to house the Collection of Pathogenic Fungi (Medical Research Council) in close association with the Reference Laboratory, since access to this collection of about 400 species is of value to the Laboratory in its teaching and research programmes.

During recent years, a better understanding of the diseases caused by fungi has been achieved, owing to a great reduction in the numbers of species of pathogenic fungi regarded as valid, and to the more universal use of recognized names for these organisms. Medical mycologists in the USA have been chiefly responsible for this progress, but a valuable contribution is to be found in the memorandum by the Medical Research Council Medical Mycology Committee (1949), *Nomenclature of fungi pathogenic to man and animals*. This terminology corresponds closely with that widely used in the Americas and in recent reliable textbooks.

1. Dermatophyte Infections

The ringworm infections comprise the bulk of the fungus diseases of Great Britain, and their incidence has undergone a recrudescence following the Second World War, as a result of relaxation of preventive measures and the movement of child evacuees. It has been, and indeed still is, the procedure of many laboratories merely to establish the presence or absence of fungi in hair, skin, and nail material by direct examination. Valuable as this step may be, information about prognosis and appropriate measures in treatment can be gained only by cultural identification of the causative species. This straightforward step, which is also providing valuable information on the epidemiological aspects of these diseases, is being undertaken by an increasing number of laboratories.

In Great Britain, we adopt the simplified classification of dermatophytes into the three genera, *Microsporum*, *Trichophyton* and *Epidermophyton*, based on the shape of the multicellular spores produced in culture, which are, respectively, fusiform, cylindrical and pyriform (Emmons, 1934). Of the three species of the genus *Microsporum*, *M. audouini* and *M. canis* occur very commonly, whilst *M. gypseum* is rare. The genus *Trichophyton* contains a small number of valid species but only six of these are of importance in Britain, namely, *T. mentagrophytes*, *T. interdigitale*, *T. rubrum*, *T. discoides*, *T. sulphureum* and *T. schoenleini*. The species *T. mentagrophytes* and *T. interdigitale*, though closely related, are considered to be distinct, but in the USA they are included as variants under the former binomial. Unlike *T. mentagrophytes*, which produces hair infections as well as tinea circinata, *T. interdigitale* tends to be limited to glabrous skin infections, especially of the feet. The only species of the genus *Epidermophyton*, *E. floccosum*, is regularly isolated.

The vast majority of hair infections are of the small-spored ectothrix type due to *Microsporum* species, and consequently diagnosis is assisted by the bright yellow-green fluorescence that is produced in hairs infected by this genus when examined under Wood's lamp. *T. mentagrophytes*, the only other cause of small-spored ectothrix infections, is not commonly seen in tinea capitis, but, since fluorescence is not produced by this species, it is necessary to select infected hairs with a magnifying lens. This also applies to the other common causes of hair infection, namely, *T. sulphureum* in which the spores are endothrix, and *T. discoides*, which produces large-spored ectothrix infections.

T. schoenleini, the etiological agent of favus, produces its own particular type of endothrix invasion, and is the only *Trichophyton* species in which fluorescence is positive under Wood's lamp; the fluorescence is dull-green, and often long lengths of hair are invaded, instead of merely the juxtafollicular portion. Scalp ringworm remains a major public health problem, and its early recognition and diagnosis are necessary first steps in the prevention of major epidemics. The cause of extensive epidemics is the human host-specific species, *M. audouini*, which is isolated in this laboratory three times more frequently than *M. canis*, the causative agent of ringworm in cats and dogs. *M. audouini* is cultured almost entirely from infections in children, and from males three times more often than from females; *M. canis* causes adult infections more often than does *M. audouini*, and the ratio of its incidence in males and females is about 2 : 1. Though more information is still required, it would appear that human transmissions of *M. canis* infection are limited to a few passages only, and with decreasing virulence of the organism. Endemic and small epidemic disease is consequently maintained by the animal reservoir of infection, though it is estimated that not more than 25 per cent of cases originate from direct contact with an infected cat or dog.

Trichophyton hair infections do not occur in epidemics and tend to be missed because of negative fluorescence, the acutely inflammatory lesions which may simulate bacterial infections, and the very slow growth in culture of species such as *T. discoides* and *T. schoenleini*. *T. discoides*, the common cause of ringworm in cattle in Britain, is especially prone to produce intractable kerionic lesions, and to cause sporadic disease of both children and adults in contact with farm

animals. Favus is not an uncommon disease and occurs in urban areas amongst families residing in overcrowded conditions. Children are attacked three times more frequently than adults, but males and females are infected with equal frequency. The examination of infected hairs should be made soon after they are mounted in 20 per cent sodium hydroxide, since the air-spaces left by degenerating mycelia of *T. schoenleini* within the hair-shaft are visible for a short time only.

Tinea pedis is prevalent amongst service men and the residents of schools and institutions, and is a cause of invalidism in miners. The true incidence of the disease is unknown, since most cases occurring in the general population are of insufficient severity to warrant medical attention. Its usual mode of transmission has not been determined with certainty, but it is probable that the majority of cases represent a recrudescence of infection following a period of local immunity, rather than a new infection acquired from organisms living saprophytically on floors or baths. The demonstration of the existence of normal carriers has confirmed the findings of Ajello, Keeney & Broyles (1945) and other American workers, and of Marples & di Menna (1949) in New Zealand. *T. interdigitale* is the commonest cause of foot ringworm; *E. floccosum* tends to be isolated less frequently than in the past. Chronic desquamating lesions are produced characteristically by *T. rubrum*, a species which has occurred to an increasing degree in recent years and which affects adults almost exclusively. It is particularly associated with infections contracted in the Far East and is the commonest cause of nail infections in this country, producing intractable and destructive lesions. *T. interdigitale* is a less common cause of tinea unguium, and *E. floccosum* is isolated only rarely. Groin infection, on the other hand, is almost always caused by *E. floccosum*. This difference in susceptibility of various body regions has been stressed by Rothman (1949). Infections of the glabrous skin are due, in the main, to animal infecting species (*M. canis*, *T. discoides* and *T. mentagrophytes*); as is usual when such species attack man, they tend to be acutely inflammatory, and are, therefore, readily amenable to treatment. *M. audouini* only rarely spreads from the scalp to affect glabrous skin, and, except during the peaks of epidemics, produces desquamating non-inflammatory lesions. Tinea barbae is also caused most often by the animal-infecting strains, *T. discoides* and *T. mentagrophytes*. The seasonal variation in incidence of dermatophyte species, suggested by Hopkins *et al.* (1947), has not, as yet, been noted.

The geographical distribution of ringworm in Britain has been studied by Walker (1950), who found that valuable epidemiological evidence may be derived from the isolation and recognition of stable variants of *M. canis* and *M. audouini*. *M. audouini* was found to predominate in isolations from the industrial areas in the north of England and the Midlands, from Glasgow and from the Belfast area. *M. canis* predominated in Leeds, Coventry, Leicester and in Devon. In London these two species of *Microsporum* were isolated with equal frequency.

A survey of animal dermatophyte infections has not been made in Great Britain. These diseases are widespread among certain animals which may transmit their infection to man, and, as is the case in human infections, it is the young which are most frequently infected. *M. canis* infection is prevalent amongst kittens, in which extensive disease may co-exist with negligible naked-eye lesions; it occurs less often in puppies. Cattle, and especially calves, are often infected with *T. discoides*; and *T. mentagrophytes* produces infection in a variety of animals including cattle, horses and rodents. *T. quinckeanum*, which is considered, by certain American workers, to be the same species as *T. mentagrophytes*, causes mouse favus, which may be transmitted to animal-house attendants and to the paws of cats.

2. Superficial Infections

Among the superficial infections, only pityriasis versicolor is diagnosed with any regularity; one recent case was unusual in presenting with generalized desquamating lesions which resembled those of dermatophytosis. Otomycosis is a rare infection, diagnosable when oedema and pain are associated with the obstruction of the external meatus by an exudate in which usually *Aspergillus niger* or *Aspergillus flavus* can be demonstrated by direct examination and by culture. It is probable that the disease represents a localized tissue hypersensitivity to infection rather than a primary mycotic disease.

3. Aspergillosis

Another *Aspergillus* species which occasionally assumes a pathogenic role is *Aspergillus fumigatus*. This ubiquitous organism is frequently cultured from sputum as a result of the inhalation of spores, but the repeated occurrence of fragments of mycelium in a freshly expectorated specimen may indicate pulmonary disease. When invasion of lung tissue does occur, however, it may be an acute process (Delikat, 1945), or it may simulate tuberculosis, or, more frequently, it may affect the walls of an already established pulmonary cavity. A tumour-like spherical colony of fungus may develop in the lung parenchyma causing haemoptysis, and infection sometimes appears to have been superimposed upon pulmonary infarcts. Aspergillosis causes a considerable mortality amongst birds in captivity in this country (Ainsworth & Rewell, 1949).

4. Infections by Yeast-like Organisms

Moniliasis is a common infection of the mouth and vagina, but less commonly of the skin, and there is evidence that such infections may be precipitated when the balance of the local bacterial flora has been disturbed by the use of antibiotics. The infections are usually sporadic and mostly endogenous, but epidemic spread sometimes occurs in maternity homes (Ludlam & Henderson, 1942), in children's wards, and in factories where the work involves frequent wetting of the hands, such as in fruit-canning. Pulmonary moniliasis has been reported in this country (Brown, 1946), but it is doubtful whether it can be regarded as a distinct disease. Bronchomoniliasis should be diagnosed only upon the evidence of bronchoscopy and radiology, combined with the results of iodide therapy; the finding of *Candida albicans* in profusion in the sputum is inconclusive. *C. albicans* is not often isolated from normal skin, but the preliminary results from a survey of yeast-like organisms in "normal" vaginal swabs indicate that this organism may be present in about 5 per cent. Other organisms isolated were *C. krusei*, which was suspected from the elongated shape of the yeast-cells in direct smears, and non-pathogenic cryptococci (Dawkins, Edwards & Riddell, unpublished observations). *C. albicans* is recognized as the only pathogenic species of the genus *Candida*; for its identification, it is required that its characteristic morphology and

sugar reactions be produced, and that chlamydospores be developed on the submerged mycelial growth in corn-meal agar.

Torulosis occurs as an unusual sporadic disease in Britain, as elsewhere in its world-wide distribution. The ecology of *Cryptococcus neoformans* has been little studied, but the organism is reported to have been isolated from fruit and milk (Carter & Young, 1950). The disease presents most commonly as a torula meningitis, and, though misdiagnosed as tuberculous meningitis, which infection it simulates most closely, it is more frequently considered in differential diagnosis. British reports include those of Magarey & Denton (1948) and Daniel, Schiller & Vollum (1949). In a recent case, the infection persisted as a pyrexia of unknown origin for several months, until the presence of budding yeast-like organisms with wide capsules was noted in sections from a single enlarged inguinal lymph node; *C. neoformans* was later cultured from another lymph node. The diagnosis of a pathogenic strain of *C. neoformans* requires the isolation of an organism of characteristic morphology which develops cream-coloured to tan or amber mucoid colonies by rapid growth both at 37° C. and at 22° C., and which is pathogenic for white mice. An avirulent strain, which is sometimes isolated from the skin, grows poorly at 37° C. and is non-pathogenic for mice, though it is otherwise identical with the pathogenic species.

5. Subcutaneous Mycoses

Actinomycosis is now receiving increased attention following the work of Erikson (1940), in which it was shown that the disease in Australian cattle is caused by an organism distinct in many of its properties from the one causing human actinomycosis in Britain. It was subsequently suggested that the anaerobic Actinomycete causing human disease be called *Actinomyces israeli*, while that from bovine infection be called *A. bovis*. It remains to be seen whether the organism isolated from bovine actinomycosis in this country conforms to the above generalization. *A. israeli* is frequently isolated from tonsillar crypts in which it exists saprophytically, and occasionally it invades the adjacent tonsillar tissues. Most strains are received from infections associated with jaw injuries, but two recent isolates have been recovered from granulomata of the lachrymal ducts.

Sporotrichosis has been reported from East Anglia but, though it has frequently occurred in France, it is apparently a very rare disease in Britain. It is probable that a certain number of cases are missed because of the absence of *Sporotrichum schencki* from stained sections of human lesions, and because of the immediate resolution which occurs when iodide therapy is begun. Positive cultures are, however, readily obtained from the granulomata.

6. Systemic Mycoses

The systemic fungus diseases are, as far as is known, extremely rare in Britain. Blastomycosis, caused by *Blastomyces dermatitidis*, has been reported only once (Dowling & Elsworthy, 1925), and then in a man who had been handling wood from the USA. Coccidioidomycosis, due to *Coccidioides immitis*, is of importance only as a laboratory-acquired infection (Nabarro, 1948). On the other hand, it may well be that histoplasmosis occurs more often than at present recognized in this country, since infection by *Histoplasma capsulatum* may reveal itself in a wide variety of syndromes. The widespread involvement of the reticulo-endothelial system which occurs mainly in infants, and which simulates visceral leishmaniasis, does not occur in Britain. The case reported by Derry, Card & Wilson (1942) may have been contracted in France; a patient recently seen in Britain contracted his infection in South Africa. Duncan (1947) has reported a case which presented with skin lesions only, and in which the encapsulated yeast-cells were unusually large. The primary benign, and often asymptomatic, pulmonary infection, described by Christie & Peterson (1945) and by Palmer (1945), is being searched for, but the two recent cases of pulmonary calcification which were associated with positive histoplasmin skin tests each gave a history of temporary residence in Canada (Arblaster, 1950). Histoplasmin skin-testing surveys have, so far, been limited, and have given negative results (McWeeney *et al.* 1946; McCracken, 1948). More extensive surveys are at the moment in process of preparation, and an active interest is being taken by veterinary medical officers in the possible existence of animal infections, especially in rats and dogs. The closely related disease of horses, epizootic lymphangitis, which used to occur in this country, is now extinct; cultural studies upon *Histoplasma farciminosum* have been described by Bullen (1949).

7. Diagnosis of Fungus Infections

For routine diagnostic work, Sabouraud's dextrose agar and 4 per cent malt-extract agar are generally used. In order to inhibit the growth of bacterial contaminants to a degree greater than is possible by the low pH of about 5.4, 0.036 per cent potassium tellurite, or 30 units each of penicillin and streptomycin per ml., may be incorporated in the medium, but, in order to obtain characteristic growth, subculture to the normal medium is necessary. Curry (1949) uses a procedure in which multiple inoculations are made on to drops of solid medium in a Petri dish, thereby achieving maximum opportunity for isolating the fungus while preventing the spread of contaminants. The identification of fungi by a simple slide-culture technique in use at the Reference Laboratory is described by Riddell (1950).

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THE DYSENTERY REFERENCE LABORATORY

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1 Classification of dysentery bacilli
2 Antigenic relationships of the dysentery bacilli
3 Variation in the organisms of bacillary dysentery
4 Serological identification
References

Bacillary dysentery was a major cause of ill-health among troops during the First World War, a fact which led in the following years to an intensive investigation of the organisms concerned. Andrewes & Inman (1919) studied the organisms of the Flexner group and established five main serological types. Boyd (1938, 1940), working in India, added three more types to the Flexner group. He also identified as causes of dysentery a number of strains which showed biochemical reactions similar to those of the Flexner series, yet were unrelated to that group antigenically. Non-mannitol-fermenting organisms were studied by Large & Sankaran (1934) and by Sachs (1943), and five new types were identified in addition to *Shigella shigae* and *Shigella schmitzi*.

Dysentery was again prevalent during the Second World War and was shown to be due to the same organisms as had previously been found, including the new types described by Boyd and others. It was feared that men returning home from the battle-fronts might introduce these new types and spread the disease among the civil population. It was decided, therefore, as part of the newly organized Public Health Laboratory Service, to institute a Dysentery Reference Laboratory to which all strains suspected of causing dysenteric symptoms could be sent for study and identification. For the present the Laboratory is situated at Oxford, but it is hoped to move it to Colindale as soon as the new building is completed. Cultures are received for examination in this Laboratory both from the laboratories of the Public Health Laboratory Service and from hospitals and institutions outside the service. Many cultures have also been sent for examination from Europe, Asia and Africa.

1. Classification of Dysentery Bacilli

The dysentery organisms are now divided into four groups, as follows:

Group 1 consists of the non-mannitol-fermenting organisms and includes *Sh. shigae*, *Sh. schmitzi* and the types described by Large & Sankaran (1934) and by Sachs (1943). These are known as Types Q454, Q771, Q902, Q1030 and Q1167. Of these organisms *Sh. schmitzi* and Type Q902 give a positive indole test; the remainder are negative in this respect.

Group 2 comprises the Flexner group, consisting of the organisms V, W, X, Y, Z, so named by Andrewes & Inman (1919), and the types described by Boyd (1940) and known as Types 103, P119 and 88. The last named is antigenically identical with the biochemical variants, the Newcastle and Manchester bacilli, described by Clayton & Warren (1929) and by Downie, Wade & Young (1933). The members of the Flexner group ordinarily ferment mannitol, though some exceptions to this rule are known. A number of sub-types of the Flexner bacilli are now recognized and are known as Types VZ, WX, 103Z, and *Shigella rabaulensis*.

Group 3 includes those organisms described by Boyd which show biochemical reactions similar to those of the Flexner group but having no antigenic relationship to them; they are known as Types 170, P288, D1, P274, P143 and D19. To these must now be added a seventh type, *Shigella etousae*, which caused much dysentery in the Mediterranean area during the recent war and has also been found in England and in Denmark.

Group 4 contains one organism only, *Shigella sonnei*.

The several varieties of *Bact. dispar* and *Bact. alkalescens* are not now regarded as coming within the classification *Shigella*. They are more nearly related to the coliform organisms.

2. Antigenic Relationships of the Dysentery Bacilli

In general, the organisms of Groups 1, 3 and 4 show no serological relationship either to one another or to any other organisms, though some exceptions to this rule are found. Thus, the Boyd Type P143 is related to the Dispar organisms, and P274 has some community of antigen with *Bact. alkalescens*. *Sh. sonnei* in its secondary phase is related to the Boyd Type D19.

The organisms comprising the Flexner group differ from those of the other groups in being closely related to one another. Several schemes showing these relationships have been published, e.g. by Boyd (1938), by Wheeler (1944), and more recently by Madsen (1949). These schemes differ in certain respects and none can be regarded as entirely satisfactory. That shown in Table I, which is based mainly on the schemes given by Wheeler and Madsen, is as accurate as

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TABLE I. ANTIGENIC RELATIONSHIPS OF THE FLEXNER BACILLI

Flexner type	Specific antigen	Group antigens
V	I	1 2 4
VZ	IS	1 2 4 6
W	II	1 3 4
WX	II	1 7
X	—	1 7
Y	—	1 3 4
Z	III	1 6 7
103	IV	1 3 4
103Z	IV	1 3 4 6
Sh. rabaulensis	IV	1 3 4 R
P119	V	1 7
88	VI	1 2 4

seems possible in the light of our present knowledge. It must be understood, however, that these figures do not represent the total antigenic complex of these organisms. A number of minor factors exist, but the inclusion of all of them would render a table of this kind too complicated. Moreover, different strains of any particular type may vary slightly in their antigenic make-up, so that what would be true for one strain might not necessarily be so for another.

It will be observed in Table I that, with the exception of *Sh. flexneri* X and Y, each of the Flexner types possesses a specific antigen by which it can be recognized. These are indicated in the table by roman numerals. In addition to these, the sub-type VZ possesses a specific antigen peculiar to itself, which is represented in the table by the letter S. The presence of this antigen was recognized in the original studies of Andrewes & Inman (1919) and it has been confirmed on many occasions by the author and by Madsen (1949).

As regards the group antigens it will be seen that a common factor, indicated by the arabic numeral 1, exists throughout the whole Flexner group. The remaining figures in the table represent antigens which are common to the different types and sub-types. Particular attention may be called to the antigen represented by the figure 6, which is present in *Sh. flexneri* Z and also in VZ and 103Z, and thus serves to separate these sub-types from V and 103 respectively. Another antigen of some interest is that which has been represented by the letter R, and occurs only in the organism *Sh. rabaulensis*. This antigen is peculiar in that, although present as a component of the group phase, it is yet specific for the *rabaulensis* sub-type.

3. Variation in the Organisms of Bacillary Dysentery

Table I shows that the Flexner organisms X and Y are devoid of specific antigen, and there has been some controversy as to their origin and their correct classification in the group. It is now generally agreed that they have been derived from the specific types by loss of the specific antigen. Thus X may be derived from WX or from Z or from P119. Y may be derived from W or from Type 103.

These variations have been seen to occur in the laboratory and are a common occurrence in Type 103. That they may occur in the body is also true, since many cultures of both X and Y have been received for examination which had been isolated as such direct from patients suffering from bacillary dysentery. Indeed, there is evidence to suggest that these non-specific organisms may pursue an independent existence as pathogenic dysentery bacilli.

Boyd (1940) was the first to observe this form of variation in Type 103. He found that, on isolation, the organism was agglutinated by its homologous serum, but to only a slight extent by sera prepared from heterologous types and from the non-specific organisms X and Y. After some period in culture, which might be a matter of days, weeks, months, or even years, the organism became highly agglutinable and would react to high titres with heterologous sera, and particularly with sera prepared from Flexner Y. These two states of the organism were named by Boyd 103A, the specific phase, and 103B, the group phase. This change in the nature of the organism is due to a gradual loss of the specific antigen and the unmasking of the group antigens, which are thus rendered sensitive to agglutination. In its final stage the organism is indistinguishable by serological tests from Flexner Y.

Sh. rabaulensis, a non-mannitol-fermenting variety of Type 103, presents specific and group phases of similar character to those of Type 103. As already mentioned, it possesses in its group antigen an additional component, which has been represented in Table I by the letter R. *Sh. rio*, which has been described by Weil, de Assis & Slafkovsky (1948) as a new Flexner type, is a degraded variant of *Sh. rabaulensis*.

The organism P119 is found to occur in two forms: the one, as shown in Table I, has a strongly marked X component in its group antigen; the other is devoid of this component, and is presumably a loss-variant. They may be referred to as the X+ and X— varieties of P119. Both forms of the organism have been isolated as such direct from the patient.

The organisms of the Flexner group are not the only dysentery bacilli to undergo variation. Similar changes, involving loss of the specific antigen, have been found to occur in *Sh. shigae*, in *Sh. schmitzi* and in *Sh. sonnei*. In the last organism the change in serological behaviour is accompanied by well-marked changes in colonial appearance. In its specific form the colonies of *Sh. sonnei* are smooth, dome-shaped, with a clean edge, and are somewhat opaque to transmitted light. In the second or group phase the colonies are larger, with ragged edge and roughened surface, and by transmitted light are more translucent.

4. Serological Identification

If an organism shows biochemical reactions which are consistent with its membership of one of the *Shigella* groups, final diagnosis must be made by serological tests. These are of three kinds: slide agglutination, tube agglutination, and absorption tests. It is unnecessary to describe the technique of tube agglutination and absorption tests, since well-established methods are in general use in all laboratories. But the technique of slide agglutination is less standardized. The

methods employed in preparation of sera for slide agglutination and in carrying out the test vary so much in different laboratories that it may be helpful to describe in some detail the methods which have been found successful in the Dysentery Reference Laboratory.

Technique of Slide Agglutination

Slide agglutination is regarded as only a preliminary test, and must be used with caution, owing to the possible occurrence of non-specific agglutination. To minimize this effect, the serum for test by slide agglutination should not be too strong. The most suitable strength is such that, when tested in tubes, the serum has an homologous titre of 1 in 50. In the test, however, one drop of serum will normally be diluted with one drop of suspension. The serum should therefore be prepared with an initial titre of 1 in 100.

For the purpose of slide agglutination a slide or plain sheet of glass is not the most satisfactory piece of apparatus to use. A glass plate with hollow depressions in its surface will be found to be more serviceable. The plate should be thoroughly cleaned and passed through a flame before use, to remove any traces of grease that may be present. One drop of serum is placed in one of the hollow depressions and to this is added one drop of concentrated suspension. The two fluids are mixed with a platinum needle and allowed to spread out to a diameter of about ¾ inch (1.9 cm.). The plate is rocked with a circular motion and in a positive test, if the serum is of the strength recommended, agglutination should be visible in about one minute.

Preparation of the Suspension for Slide Agglutination

The suspension for slide agglutination is prepared in a 1 in 1,000 solution of mercuric iodide in physiological saline solution. A stock solution is made as follows:

Mercuric iodide	1 g.
Potassium iodide	4 g.
Distilled water	100 ml.

The 1 in 1000 solution is prepared from the 1 in 100 solution as follows:

Mercuric iodide (1 in 100 solution) . .	10 ml.
Physiological saline solution . . .	90 ml.
Formalin (to prevent autolysis) . .	1 drop

Both these solutions keep indefinitely.

The growth on an agar slope is washed off in a small quantity of the 1 in 1,000 solution and further diluted as necessary with the same solution. These suspensions are used in concentrated form, having an approximate density of 4,500 million organisms per ml.

Preparation of Sera for Slide Agglutination

As already mentioned, sera for slide agglutination should be prepared with an homologous titre of 1 in 100. In *Shigella* Groups 1, 3, and 4, there is little or no cross-agglutination between the several organisms in each group; all that is necessary, therefore, is to test the sera against their homologous cultures and reduce the titre to that recommended.

In the Flexner group, owing to the extent of cross-agglutination which is found between the several types, the group agglutinins must be removed by absorption. Several methods have been devised for this purpose, the aim of which has been the production of two sets of sera: the one, a range of sera specific for the individual types; and the other, a series embodying the different group factors shown in Table I.

In the Dysentery Reference Laboratory a somewhat different system has been worked out, and is set forth in Table II. It has the advantage that by its use it has been found possible to recognize all types and sub-types, including the non-specific organisms X and Y, by means of a single set of sera.

TABLE II. PREPARATION OF SLIDE-AGGLUTINATING SERA

Slide serum	Crude serum	First absorption with	Second absorption with
V	V	103B	P119X —
Specific VZ	VZ	V	Z
W	WX	X	103B
X	X	Y	P119X —
Y	Y	X	—
Z	Z	X	Y
103	103A	Y	—
P119	P119X +	X	—
88	88	Y	VZ

Table II shows, in the third and fourth columns, the absorptions necessary to obtain from the crude sera in the second column the slide-agglutinating sera in the first column. In each case the first absorption is the main one, and serves to remove the greater part of the unwanted group agglutinin. With sera having an homologous titre of about 1 in 2,000, it is sufficient to use the growth from one Roux bottle per ml. of serum. The second absorption clears up any remnants of group agglutinin that may remain, and can be effected by the growth from half a Roux bottle per ml. of serum. The two absorptions may be carried out simultaneously if desired.

The growth on the agar surface in a Roux bottle is washed off with the 1 in 1,000 mercuric iodide solution and the suspension is set aside for an hour or two. The organisms are then spun down in the centrifuge and the supernatant fluid removed. One ml. of undiluted serum is then added to the centrifuged organisms. Serum and organisms are thoroughly mixed by drawing them back and forth in a pipette and, after capping, the tube is placed overnight in the incubator at 37° C. On the following morning the serum is removed by centrifugation and tested against a suspension of its homologous type. The titre is then reduced to 1 in 100 as recommended above.

Diagnosis by Slide Agglutination

Table III shows the results obtained when testing the slide-agglutinating sera against suspensions of the different types and sub-types of Flexner bacilli. It will be observed that V serum agglutinates both V and VZ, though the latter is distinguished from V by its agglutination also with Z serum. VZ can also be diagnosed by its agglutination with the specific VZ serum containing the factor S.

TABLE III. DIAGNOSIS BY SLIDE AGGLUTINATION

Slide-agglutinating serum	Suspension of Flexner organisms												
	V	VZ	W	WX	X	Y	Z	103 A	103 B	103 Z	P119 X+	P119 X−	88
V	+	+	−	−	−	−	−	−	−	−	−	−	−
Specific VZ	−	+	−	−	−	−	−	−	−	−	−	−	−
W	−	−	+	+	−	−	−	−	−	−	−	−	−
X	−	−	−	+	+	−	+	−	−	−	+	−	−
Y	+	+	+	−	−	+	−	−	+	−	−	−	−
Z	−	+	−	−	−	−	+	−	−	+	−	−	−
103	−	−	−	−	−	−	−	+	+	+	−	−	−
P119	−	−	−	−	−	−	−	−	−	−	+	+	−
88	−	−	−	−	−	−	−	−	−	−	−	−	+

The W serum agglutinates both W and the sub-type WX. The two are distinguished by the fact that W is also agglutinated by Y serum, while WX is agglutinated by X serum.

Although the X serum agglutinates WX, X, Z and P119X+, yet the organism X is itself agglutinated only by X serum. Similarly, although Y serum agglutinates V, VZ, W, Y and 103B, yet Y itself is agglutinated only by Y serum. The two non-specific organisms X and Y are thus readily identified.

Flexner Z is agglutinated by both X and Z sera and is thus distinguished from Flexner X, which is agglutinated by X serum only.

Type 103A (specific phase), 103B (group phase) and the sub-type 103Z are all agglutinated by 103 serum. They are distinguished by the fact that 103B is also agglutinated by Y serum, and the sub-type 103Z by Z serum.

The X+ and X− varieties of P119 are distinguished by the agglutination of the former with X serum, while the latter is unaffected.

The 88 serum is specific for the 88, Newcastle, and Manchester types.

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SEROLOGICAL CONTROL OF VENEREAL DISEASES

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1 Public health measures
2 Serological control in the treatment of patients
3 Improvements in serological technique
4 Future progress
5 Conclusions
References

The control of venereal disease by serological methods falls naturally into two main divisions, namely (i) preventive and public health measures, and (ii) the more individual methods applied to the cure of patients suffering from these diseases. In the treatment of patients, the reactions employed are complement-fixation tests for syphilis, gonorrhoea and lymphogranuloma inguinale, and various precipitation tests for syphilis.

1. Public Health Measures

In Great Britain, unfortunately, serological control of venereal disease (in the public health sense of the phrase) is inadequate. When we compare it with its counterpart in the USA, it might be said with justice that we are not doing enough in this sphere of preventive medicine. In the USA, with characteristic vigour, public health authorities have for some years been performing blood tests on a big scale. For instance, every entrant into the armed forces is subjected to at least one blood test for syphilis. Mass blood-testing surveys have been instituted among large sections of the community, and every immigrant who wishes to enter the country has to submit to these tests. Moreover, in most hospitals all in-patients, in addition to antenatal patients and blood donors, are tested as a routine. In contrast, in Great Britain routine blood tests for syphilis are restricted to blood donors, some patients at antenatal clinics, a few persons who seek blood tests before marriage, and a small number of contacts who are persuaded to come to the public venereal diseases (VD) clinics for examination. If American experience in these matters is justified, it will be seen that the scope for attempting to control venereal disease by means of blood tests can be greatly enlarged. Whether this attempt will ever be made seems doubtful. Ignorance among the general public, the indifference of the general medical practitioner, and the continued prejudice of all sections of the community perpetuate an inertia that will be difficult to overcome. Even the Life Insurance companies are curiously reluctant to use serum reactions when prospective applicants are medically examined. Now that penicillin has come to be regarded as the cure-all for venereal disease, the seriousness of the problem has tended to be neglected. The public at large seem to prefer to ignore the ravages of venereal diseases, and the claims of innocent sufferers such as congenital syphilitics are hardly admitted. During the war, it is true, much was done in the educational field by advertising campaigns and public meetings and, for a time, there was the attempted use of legal compulsion by means of Regulation 33B.[1] In the present more peaceful times, Regulation 33B has been suspended—and is not mourned; unfortunately, advertising and public meetings to a large extent have also been dropped.

It is suggested that, from an economic angle alone, blood testing for syphilis might be undertaken with advantage among more of the population. A start would be made if all patients at antenatal clinics and all hospital entrants were tested as a routine measure. The cost to the country would be small and the information gathered would be of considerable value. Even so, it would leave us a long way behind the USA, where one laboratory in New York does an average of 3,000 serum tests a day.

2. Serological Control in the Treatment of Patients

The other side of the picture, that is, the serological control of patients suffering from venereal disease, is much brighter. Since the war the standard of control has been improved and may well be said to be in the front rank when compared with that in other countries. This happy result is due in part to the clinicians in charge of the VD clinics throughout the country; these experts have demanded, and are getting, a high standard of work in serological testing. During recent years there has been an influx into the laboratory services of young enthusiastic bacteriologists who have been trained in serological methods; some of these have also had clinical experience of venereal diseases. When the new services were introduced, certain laboratories were given the task of looking after the various venereal disease clinics in their area. Efforts were made, and on the whole were successfully made, to perfect the liaison between the laboratories and the clinics so that the clinician would consult the pathologist and vice versa when the necessity arose. In addition to this, the Public Health Laboratory Service took over the old Ministry of Health Venereal Diseases Laboratory and designated it the Veneral Diseases Reference Laboratory. Its functions are the production of standard reagents, the testing of sera which give anomalous results in other laboratories, the teaching of bacteriologists and technicians who wish to add to their knowledge of technical methods, and the carrying out of research work. That there is a need for such a laboratory is shown by the increase in the supply of standard reagents as well as in the examination of what might be called problem sera. Thus, to take these two examples: (i) in 1946–47, 10,721 ml. of preserved guinea-pig serum (complement) were supplied, compared with 34,216 ml. in 1948–49; (ii) in 1945–46, 246 problem sera were examined, compared with 2,346 in 1948–49. This increase is not limited to any particular branch of the laboratory work.

Finally, there were a few special VD laboratories which were attached to VD clinics, all situated in teaching hospitals. These, of course, remain and carry on their work. Such is the general design of the serological control of venereal disease as it exists in Great Britain today.

[1] Regulation 33B, issued in 1942 under the Defence (General) Regulations empowers a medical officer of health to require the submission to examination and, if necessary, treatment of any person alleged by two separate persons to have been a source of infection.—Ed.

3. Improvements in Serological Technique

With regard to the type of work done, this has altered greatly since 1939. In what seems to be those far-off days, few laboratories which did serum tests for venereal diseases used techniques that could be compared in either method or sensitivity to those of today. Each laboratory had its own particular methods, not only of performing these tests but also of reporting the results. The usual method was to report positively reacting sera in terms of a varying number of positive signs which gave little real indication of the strength of the reaction; such reports, when they came into the hands of a clinician who was not familiar with the particular technique used, were sometimes almost incomprehensible. Quantitative serum testing, as it is done today, was not often carried out (the sigma test was one exception), and there were few attempts to measure the sensitivity of the various techniques employed. Thus the anomaly arose that a patient in one county might be said to be suffering from syphilis whilst in another he would be accounted free from that disease. There had been in the past an attempt by the Ministry of Health to assess the work of the special laboratories which were subsidized by the State to do serological testing for venereal disease. The method adopted was not well received, since it necessitated visits by a serological expert, and these, more often than not, were heartily resented. This approach ceased in 1936, when the control of venereal diseases passed into the hands of the local authorities. There followed a resurgence of original work on the methods of performing the Wassermann test as well as on the precipitation tests then in vogue. Unfortunately, the onset of the war tended to retard this work, but one first-class research investigation which was well under way at this time did emerge. This was Richardson's work on preserved guinea-pig serum. He published a paper in 1941, but owing to the state of the country at that time it was apparently overlooked and did not receive its due until the end of the war. By this time penicillin treatment of syphilis was proceeding apace and, owing to the speedy action of this antibiotic, clinicians demanded a better serological service. At first this resulted in each patient having many more blood tests in a shorter time, and from this rapidly developed the routine of doing quantitative tests on all sera yielding positive results. By means of these the clinician could follow and assess the reaction of the body against the disease while the patient was under treatment. At the same time, owing to the fact that, for purposes of the test, Richardson's preserved guinea-pig serum is almost heat-stable, serologists were able with safety to increase the sensitivity of their complement-fixation reactions.

In addition to all this, much work was done on the introduction of more sensitive Wassermann antigens and the more accurate titration of these antigens by means of optimal proportions (Price, 1950). Thus the whole trend of complement-fixation tests for syphilis was towards sensitivity. Towards the end of the war knowledge of the production of cardiolipin by Pangborn (1945) and Maltaner & Maltaner (1945a, 1945b) in the USA had reached Great Britain; at the present time the value of this reagent is being studied in many centres. First impressions agree with those of our American colleagues, that here we may have a reagent of greater sensitivity and specificity than the usual crude heart extract which has been in use for so many years. Possibly as a result of the employment of serological tests which are very much more sensitive than they were another problem has arisen, that of the so-called biological false positive. A large amount of work has been done by a subcommittee in America on this problem, but little accurate knowledge of how to deal with it has been obtained.

The most hopeful line at the moment appears to rest with a further extension of the work already done by Nelson & Mayer (1949) of Baltimore. The former has evolved an immobilization test which reveals the presence of a specific antibody in the serum of patients suffering from syphilis. This antibody is entirely different from the reagin concerned in any of the usual complement-fixation or precipitation tests for syphilis, and is said to be absent from sera exhibiting so-called biological false positive reactions. Unfortunately, the technique is somewhat complicated but with the passage of time it will, no doubt, be simplified. If this can be done it would appear that the possibility of revolutionizing the diagnosis of syphilis by laboratory methods may become an established reality.

4. Future Progress

What remains to be done ? In the opinion of the writer it would appear that some practical and fundamental problems must be tackled. First of all, the comparison of the various techniques, both complement-fixation and precipitation, should be undertaken so as to evaluate their specificity and sensitivity. At the moment it seems that these tests fall into three groups, which may be described as (i) the relatively insensitive, (ii) the safely sensitive, and (iii) the supersensitive.

Those which are relatively insensitive can easily be eliminated by comparative testing. The last two groups, however, merge into one another in such a way that it is difficult to fix a dividing line, and until a standard of reference is available the classification of some of the techniques used into either of these two groups is bound to cause difficulty. Many attempts have been made, as, for example, at the Copenhagen serum conferences of 1923 and 1928 held under the auspices of the League of Nations, and at an American conference in 1942, to compare the sensitivity of various techniques. A further conference is to be held by the World Health Organization in 1951, in an attempt to solve this problem. It might also be mentioned that in the area of the North East Metropolitan Regional Hospital Board of London an experiment is being carried out in an attempt to assess the relative sensitivities of serum tests which are used for the diagnosis of syphilis in this area. It is too early to come to any conclusions, but this would seem to be a move in the right direction. No doubt this experience will lead to other regions carrying out similar comparisons, and it should not be beyond the bounds of possibility for a serum conference to be staged on a national scale in the near future. This should be a great help to all pathologists who have to carry out serum tests for syphilis.

During the last few years, as has been stated already, the tendency has been to increase the sensitivity of all serum tests, and the stage has now been reached when many are known to be supersensitive. From this the idea has developed that it is a good practice to use supersensitive tests in routine examinations in order to screen sera into those giving positive and negative reactions. The positive sera are then tested by one or more of the safely sensitive techniques and a final decision is reached. This method of testing and reporting of sera is favoured particularly in the USA where it is said that

by its routine adoption few, if any, cases of early syphilis are missed. Nevertheless, these methods are not without danger. For instance, if a positive serum reaction is obtained by a supersensitive test, in spite of the fact that there is subsequently proved to be no evidence of syphilis, some clinicians, and even serologists, may be influenced by the principle that there is no smoke without fire. Again, in laboratories not in direct contact with patients, such tests might be misapplied. They might, in fact, be adopted as a routine procedure, and thus cause many patients to be wrongly diagnosed and treated as syphilitic. Furthermore, the employment of supersensitive tests in therapeutic control may render it difficult for the clinician to decide how much treatment is required by individual patients. Thus it will be seen that the importance of coming to some conclusion as to what degree of sensitivity is desirable for any particular test is of paramount importance.

The problem of biological false positives has arisen in recent years and has assumed proportions that demand the attention of all concerned. The percentage occurrence of this phenomenon in routine testing varies widely. Figures in Great Britain range round about one per cent, but in other countries they seem to be very much higher. Whether this is due to the use of more sensitive tests in these countries is a point that should be investigated. It has been suggested that the results of any given test vary according to the geographical latitude in which it is employed. Thus, a technique that is reasonably specific in New York has been found, when employed in Guatemala, to yield a considerably higher percentage of biological false positives. The effect of pregnancy in the production of these reactions certainly requires investigation. In Great Britain little work has been done, and it would seem that a full-scale investigation is necessary. When the phenomenon of biological false positives first attracted attention, the list of diseases said to be responsible was indeed formidable; during the last few years most of these have been eliminated by competent workers, but there still remains a residue big enough to cause concern. No doubt at the outset the problem was magnified by the lack of skill on the part of some workers but, as the standard of proficiency advanced, the problem tended to be seen in its true perspective. So far as is known, no work has been carried out in this country on Nelson's immobilization technique for the diagnosis of syphilis. From reports in the American press and from the practical demonstration given to the writer it would seem that this new method of approach holds great promise for the future. Results so far indicate that it is possibly the one practicable method of distinguishing biological false positives from true reactions. Furthermore, it is the only specific reaction known at present for the detection of syphilis. All these investigations are considered to be worth while, but it should be mentioned that in Great Britain little money is allocated to research work on problems of venereal disease. In fact, so far as is known, there is in this country only one scholarship devoted entirely to research work in venereal diseases.

5. Conclusions

It would seem that, at the moment, the position with regard to the serological control of venereal diseases is as follows:

i. In the field of public health much more could be done than has yet been attempted, and it is suggested to those responsible for this field of medicine that they investigate the matter much more fully than they have in the past;

ii. That, though the standard of work in the serological control of patients under treatment has much improved in recent years, there is no room for complacency;

iii. There remains a large field for investigation, not only of the older serological methods of diagnosis, but in the newer field of specific reactions.

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THE WORK OF AN AREA PUBLIC HEALTH LABORATORY

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1 Diagnostic services
2 Preventive sanitary services
3 Research
4 Investigation of epidemic disease
5 Miscellaneous functions
6 Relations with other bodies
7 The future
References

The Public Health Laboratory at Taunton draws its material from an area of about 1,600 square miles with an approximate population, in 1948, of 460,000. The area contains four towns with between 20,000 and 40,000 inhabitants in each, the remainder being a rural district, heavily farmed except for the thinly populated Brendon Hills and Exmoor at its western limit. Taunton is a centre of road and rail communications connected by direct public transport services with every town and large village within 25 miles. Beyond this and away from the trunk railway lines communications are less satisfactory, and for this and other reasons an efficient service cannot be provided further afield.

For descriptive purposes the day-to-day work of the laboratory may be divided into the diagnostic services for practitioners and medical officers of health, the preventive sanitary examinations, and the research programmes. To these must be added investigations, from time to time, into the origin and spread of epidemic disease occurring within the area, not only with the immediate object of assisting in its control, but as part of an attempt to collect accurate information on the subject which may in due course throw light on the principles governing such incidents.

No two area laboratories can be said to work under identical conditions. The density of population in the area served, the occupations of the inhabitants, and the presence of a great port or a holiday resort, are factors which may well influence the frequency and nature of infectious disease. The laboratory at Taunton is therefore typical of the others only in that the area served includes urban and rural communities with a wide variety of occupations ; in a similarity (but not, it must be understood, a standardization) of technique, both in the laboratory and in the field, which allows reasonable comparison of results with those of other laboratories ; and in an interest devoted essentially to the preventive rather than the curative aspects of medicine. The staff of this particular laboratory comprises a director, eight technicians, and secretarial and other necessary personnel.

1. Diagnostic Services

Bis dat, qui cito dat must be the motto of an efficient diagnostic service. Every effort must be made to speed the passage of the specimen to the laboratory. In a rural district a courier service is not possible since each of three dozen specimens arriving on one evening may come from as many different doctors scattered throughout the area. Within Taunton and its suburbs delivery is usually by hand ; from further afield it is by train or omnibus, and the laboratory messenger collects from railway and omnibus stations four times daily. In extreme emergency the laboratory will send its own motor van to collect a specimen from outlying parts of the area. These arrangements allow most diagnostic specimens to be examined on the same day on which they are collected by the doctor. Sending a specimen by post necessitates a delay in transit up to 24 hours—unless facilities for special delivery are available—and is avoided whenever possible. There is, however, no other practicable method of delivery from the more distant parts of the area.

Sterile containers and swabs are available to any practitioner on demand, and a replacement is sent as soon as a specimen is received. Some public health departments maintain a larger supply for use in their own clinics and for emergency issue to local doctors. The variety of containers is kept as small as possible and the packings designed so that they may be sealed with a printed address label. All those submitting specimens are asked to complete a standard form (varying with the nature of the specimen) which records, besides the patient's name, age, and sex, such details as are relevant to the proper use of the specimen and to its epidemiological significance. This is done willingly and helpfully in almost every case.

It must be emphasized that the diagnostic service is limited to infectious disease in its widest sense, and that the examinations made are directed to this end. Clinical pathology and biochemistry, except in so far as they assist in this object, are outside the scope of the laboratory. The number of diagnostic specimens examined in 1949 was 10,865. The technical methods used in diagnostic bacteriology do not differ widely from those in general use in Great Britain (see Mackie & McCartney, 1948). It is a rule of the laboratory that there is no routine examination for any kind of specimen, i.e., each specimen is looked at in the light of the information on the form accompanying it, and the result reported in such a way as to be most useful to the sender. It may be worth while to give two examples of this practice. It is customary to examine all faecal specimens from men of military age for the presence of cysts of *Entamoeba histolytica*, though such a procedure applied to faeces of infants would be a waste of time in England. In one part of the area infrequent cases of anthrax occur among workers in the leather trade, and it is thought worth while to keep the possible presence of *Bacillus anthracis* in mind when examining all likely material from patients living there. It is a corollary of such practice that the work of the diagnostic laboratory must be under the constant supervision of a medically qualified bacteriologist.

Speed is as important in reporting the findings of the laboratory as in transmission of the specimen. As far as is possible all results which appear to deserve it are telephoned to the sender on the morning after the specimen is received. Obviously, many examinations cannot be completed within this time, but an interim message by telephone to reassure or

warn the practitioner is worth the time consumed, not only for its immediate utility but because it allows of personal contact and discussion between the laboratory and practitioner. Further information and questions on one side, and suggestions for additional examinations on the other, bring an entirely new life to the relation between doctor and laboratory, to their mutual benefit. A written report follows by post, with copies to the medical officer of health or other parties who may have an interest in the matter. In some circumstances a complete report is neither possible nor essential immediately. The identity of a *Salmonella* (unless it be *Salmonella typhi*) has no influence on the immediate treatment or disposal of the infected person, or on the measures to be taken in the interest of the public health. It is reported as salmonella infection to the practitioner and medical officer of health as soon as its nature is established. The organism is sent to the Salmonella Reference Laboratory for species identification and, while this report is awaited, attention is devoted to investigation into the history and circumstances of infection and to the examination of such other material as may have a bearing on its origin. Similarly, it suffices for his immediate purposes for an obstetrician to know that a puerperal infection is due to *Streptococcus pyogenes* (Group A). An attendant who is found to harbour a similar organism in the nose must be removed from duty as a matter of common prudence, but attribution of the infection to this attendant must await the typing of these organisms by the Streptococcal Reference Laboratory.

In these cases the reference laboratory supplies information the major value of which lies in the search for the source of infection and the prevention of further illness. The work of other of the reference laboratories bears a rather different relation to the area laboratory. The staff of the area laboratory are competent to identify most of the fungi commonly causing human disease ; there will always remain less common species, pathogenic or saprophytic, which must be sent to the Mycological Reference Laboratory. As a general rule the area laboratory has neither the knowledge nor the equipment for the diagnosis of virus diseases, and in this field its activities are limited to the selection, collection, and dispatch of material to the Virus Reference Laboratory, and the subsequent interpretation of the findings to the practitioner. With the development of serological techniques and oviculture it is to be hoped that, before long, the procedures for the diagnosis of many commoner diseases due to viruses and rickettsiae will be within the compass of an area laboratory.

2. Preventive Sanitary Services

Tests in connexion with sanitary services are for the most part done at the request of the officers of local government authorities and on samples collected by them.

Samples from 269 piped water supplies, owned by local authorities, water companies, and private landowners, are submitted for testing at regular intervals. Of these, 58 supplies to major centres of population are tested at monthly or shorter intervals, and the remainder quarterly. It is thought that more frequent sampling of the larger supplies is desirable, but the responsibility for this lies not with the laboratory but with the local authority concerned. The results obtained do at any rate allow a picture of the safety or otherwise of a supply to be built up over a period of years, and confirm the view that, in an area such as this, unsafe water is as often due to misuse or neglect of satisfactory plant as to the wilful use of an unsound supply. The tests used as a routine are the presumptive coli count with subsequent differentiation into faecal and non-faecal types (Ministry of Health, 1939). These methods are found satisfactory when applied to supplies of better quality, but the frequency of faecal contamination of animal origin makes the laboratory testing of the smaller supplies and of wells (which supply much rural water) appear to be of less value than an intelligent survey of the site. A recent addition to this work has been the examination of water supplies to farms in connexion with the requirements of clean milk production.

The laboratory tests used in the routine examination of milk are laid down by statute (Statutory Instruments, 1949). Milk from 31 plants licensed for pasteurization and sterilization is tested at weekly intervals, and milk supplied to public schools, quarterly. At the moment encouragement is being given to local authorities to submit for testing at monthly intervals all milk sold to the public. In urban districts this is done on a considerable scale, but for many supplies not so often as to provide any guarantee of freedom from infectious disease or keeping quality. In rural districts where much milk is purchased directly from the producer the position is even less satisfactory. Biological testing of milk for the presence of tubercle bacilli is applied, as far as the resources of the laboratory allow, to raw milk sold to the public in those parts of the area where bovine tuberculosis is known to be prevalent ; it is doubtful if it has any useful effect beyond an educative one.

Ice-cream is submitted for testing at regular intervals by many local authorities. The reductase test alone is used (Public Health Laboratory Service, 1947). The improvement in quality during the last two years as judged by this test is most obvious, and seems to be due to an honest effort by the trade to improve methods of manufacture and handling. Since the reductase test has never been accorded any statutory validity, this seems an excellent example of the value of an educative rather than a penal approach to the problems of food hygiene. Other foods are seldom submitted to tests unless they are suspected to be the cause of disease. At the request of the Somerset County Council a test for the bacteriological cleanliness of dishes has been devised to assist in the campaign for hygiene in the kitchens supplying schools with meals.

3. Research

To the inquiring mind the examination of routine specimens presents an almost infinite number of problems of major and minor importance and, in many instances, provides the material of research itself. The use to which it is put will naturally depend on the interests of the bacteriologist. A change in technical method will often arise from the *ad hoc* needs of the investigation of an epidemic. Only trial under a variety of circumstances will show if such a change is a useful and reliable advance, and, its validity established, it may in turn be profitably applied to some fresh and unrelated problem. But research in a public health laboratory need not be and is not entirely utilitarian ; the rationale of a technical advance may in fact be more interesting than its applications. The frequency and duration of the carrier state, the occurrence in sick and healthy persons of parasites of doubtful pathogenicity, the constancy or otherwise of the types of organisms causing disease, are all subjects about

which much may be learnt from the systematic analysis of well-kept records of routine specimens. More, however, can often be learnt by the pooling of results of two or more area laboratories, and such collaboration within the Service is accepted as the most useful approach to many problems of this kind. In addition, several laboratories have from time to time joined in planned inquiries under standardized conditions, where the problem required the largest possible number of accurate observations ; examples of these have been the testing of the efficacy of some prophylactic, the grading of ice-cream on the basis of cleanliness, and the safety of a pasteurization process.

4. Investigation of Epidemic Disease

The assistance of the laboratory in the investigation of epidemic disease may be asked at any time and in a variety of circumstances, ranging from a water-borne outbreak of enteric fever to thread-worm infestation in a boarding-school. Those met with most frequently are outbreaks of food-poisoning (of which those due to *Staphylococci* and unknown causes far outnumber salmonella and shigella infections), of upper respiratory tract infection in schools and barracks, and of streptococcal and staphylococcal infection in maternity hospitals. It must be admitted that it is rare for an investigation of an outbreak to be begun until infection is widespread and the original source hard to find with certainty. Moreover, many human factors prevent any investigation being as detailed or complete as is ideally desirable. Investigations may lead to rapid detection of a source of infection and measures to make it harmless or, more often, to no more than a reasonable guess at the origin of the outbreak in circumstances in which remedial measures are either too late or impracticable. Nevertheless, with the interchange of information between the area laboratories and the co-operation of the reference laboratories, a corpus of knowledge and experience accumulates to guide the investigator along profitable paths of inquiry when faced with an epidemic and to help him, bit by bit, to trace the network of factors concerned in the spread of epidemic disease. It is a sound rule that a director of a laboratory shall be prepared to investigate an epidemic in person and on the spot. Written reports or conversations on the telephone are no substitute for direct contact with a practitioner or medical officer of health, or for personal inquiry. The major factor limiting such investigation in the field is distance from the laboratory.

5. Miscellaneous Functions

The area laboratory is responsible for the distribution of certain prophylactic substances, notably the diphtheria prophylactics, to the practitioner. In consequence of this function the laboratory receives many requests for advice on inoculation and similar procedures directed against infectious disease. A small library of textbooks and journals, reinforced by circulating periodicals and a catalogue of current publications, is designed for use in the laboratory and is also used by the doctors in the neighbourhood.

In a rural area veterinary and human medicine meet at many points, and it is a pleasure to establish close professional relations with the private veterinary surgeons and the Regional Veterinary Laboratory of the Ministry of Agriculture. Salmonella infections spread from cattle to man, and the distribution and dispersal of cow-pox and the incidence of Q fever in cattle and man (and especially in veterinary surgeons) are examples of problems which have led to such co-operation.

Miscellaneous information upon many aspects of infectious diseases accumulates quickly in a laboratory handling material from such varied sources, and some of this has more than local interest. To enable this knowledge to be shared and used to best advantage the laboratory makes a weekly return, not only of specimens handled under their various categories, but of unusual findings and of outbreaks of more than trivial importance. Such reports, summarized and classified by the headquarters staff, are circulated to the area laboratories who thus learn, week by week, of the incidence of disease elsewhere and the activities of their colleagues.

6. Relations with Other Bodies

Contact with other area laboratories is not however limited to such formal communications. Epidemic disease recognizes no man-made boundaries and is, as a matter of course, notified directly to neighbouring laboratories if it seems possible that similar infection may occur within the area served by them. Similarly, help is sought from other laboratories in tracing the origin of infection contracted elsewhere, in the " follow-up " of infected persons who have left the district, and from time to time in the loan of staff or equipment to meet such extraordinary demands as may be occasioned by an outbreak of enteric fever. The flexible integration of the Service as a whole depends to a large part on the initiative and amicable co-operation of the individual laboratories. The reference laboratories supply expert advice in their own province and the headquarters staff give technical and administrative guidance when it is sought, in addition to taking most of the responsibility for finance and supplies. Unburdened by these problems of administration, the area laboratory, alone or with others, can devote its time to its proper functions.

It was emphasized earlier that the area laboratory was concerned with the detection and control of infectious disease only. Critics have complained that its function overlaps with and duplicates the work of the hospital laboratories. To judge by experience in the area of Taunton, this is not so. In general practice the distinction between the diagnosis of infectious disease and the investigation of other illness is usually a clear one. The doctor wishes to know if his patient is a source of danger to his family and neighbours and to treat or dispose of him accordingly. Specimens from isolation hospitals come to the area laboratory for diagnostic purposes and to insure that no patient is discharged while still a source of infection. Co-operation with the hospital laboratory allows specimens which do not seem to fall within the province of the laboratory to which they are sent to be forwarded to the more appropriate destinations at once. There is bound to be occasional overlapping, but this practice and the interchange of reports prevent any serious loss of efficiency on either side. The essential difference between the staff of the area public health laboratory and the hospital bacteriologist lies in their field of interest. The latter must work in close association with the hospital ward and its staff, with his interest devoted, especially today, to the curative aspects of medicine : the part of the former is the study of the natural history of infectious disease wherever it may occur.

Relations with the medical officers of health are cordial and mutually helpful. It is hoped that the restriction on the field of activity of the medical officer of health arising from the National Health Act, 1946, will allow him more leisure for epidemiological studies and co-operation with the laboratory.

7. The Future

The volume of diagnostic work rises steadily with a wider knowledge of the possibilities of bacteriology and the emergence of a generation of doctors raised in the newer disciplines. New technical methods will improve the efficiency of the laboratory, and experience will direct investigations more profitably than in the past. The desirability of decentralizing the diagnosis of virus diseases has been mentioned. There is no reason to think that finality has been reached in the methods of examining water or milk ; suggested improvements in method can be put on trial in a laboratory such as this and, in identical circumstances, in many similar laboratories throughout England and Wales. In this district of Somerset a radius of about 25 miles seems to be the limit within which it is possible to provide an efficient diagnostic service, and to engage in investigations in the field without neglect of other duties. Planned or projected laboratories will in time relieve this laboratory of trying to provide services for more distant parts. It is probable that the services of a trained epidemiologist might be employed profitably, especially if they were shared among other public health laboratories in south-west England. The everyday problems of epidemiology which await solution are almost countless. What constitutes the dangerous carrier of *Streptococcus pyogenes* and how may he be recognized ? What is the origin of the sporadic familial infections with salmonellae which are so common in the summer months ? What is the reservoir of so many virus infections in the inter-epidemic periods ? A single area laboratory is most unlikely to provide much help in any of these problems : the pooled experience of them all may well give an answer.

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Notes on Contributors

DR H. J. BENSTED is Director of the Central Public Health Laboratory and the Standards Laboratory for Serological Reagents. He was educated at Guy's Hospital and joined the Royal Army Medical Corps in 1916 ; from 1918 onwards he was continuously engaged in pathology in laboratories in England and countries overseas, including Egypt and India. From 1940 to 1945 Col. Bensted was Assistant Director of Pathology at the War Office. In 1946 he retired from the Army and joined the Scientific Staff of the Medical Research Council. His interest has been centred in immunology and antigenic structure and especially in typhoid, *Salmonella*, and the dysentery organisms. He published an important series of papers in the *Journal of the Royal Army Medical Corps* on *Salm. typhi* and antityphoid inoculation, and he has contributed a chapter on active immunization against typhoid and paratyphoid fevers to *Modern practice in infectious fevers* (ed. Banks, 1951).

DR J. A. BOYCOTT has been Director of the Public Health Laboratory at Taunton since 1946. He was educated at Oxford, and at University College Hospital, London, where he held appointments in the Department of Pathology. Later he was for four years assistant bacteriologist at St. George's Hospital, and during the Second World War he commanded a mobile bacteriological laboratory. His immediate interest is the study of the spread of infectious disease in a rural community.

DR R. F. BRIDGES was educated at University College, Oxford, and the London Hospital. He joined the Royal Army Medical Corps in 1910 and served in India throughout the First World War. He qualified as a specialist in pathology and was later appointed to the Enteric Convalescent Depot and Laboratory, Naini Tal and Kasauli. In England Dr Bridges was at one time in charge of the vaccine and serum departments of the Royal Army Medical College. He retired from the Army in 1937 and was appointed to the charge of the Standards Laboratory for Serological Reagents at Oxford, under the Medical Research Council. In 1945 he was appointed Director of the Dysentery Reference Laboratory in the Public Health Laboratory Service, from which he retired in 1950. Dr Bridges has published papers on new *Salmonella* types, on the diagnosis of dysentery organisms and on the preparation of suspensions for the Weil-Felix test.

DR W. C. COCKBURN graduated M.B., Ch.B. from Aberdeen University in 1936 and qualified D.P.H. at London University in 1946. In addition to service in the Royal Army Medical Corps, he has held a number of hospital appointments, and is now an epidemiologist in the Public Health Laboratory Service.

DR G. T. COOK has been Deputy Director of the Public Health Laboratory, Oxford, since 1949. He was educated at Queens' College, Cambridge and at King's College Hospital, London. After some years in general practice he held appointments as pathologist in the Emergency Medical Service, demonstrator in pathology and assistant clinical pathologist in King's College Hospital, and as bacteriologist in the Public Health Laboratory Service, Oxford. He assisted in the survey of poliomyelitis carried out in the Oxford region in 1947. During the past few years he has published papers on bacteriology, particularly on such subjects as the investigation of outbreaks of various infectious diseases.

DR S. T. COWAN is at present engaged in the reorganization of the National Collection of Type Cultures, Colindale. Among a number of hospital and university appointments he was Lecturer in Bacteriology at Manchester University from 1938 to 1946, during which time he served as a pathologist in the Royal Army Medical Corps from 1940 to 1945. His research work has been on the academic aspects of bacteriology, particularly in relation to classification, and the best known of his publications are on the classification of staphylococci.

DR A. FELIX is Director of the Central Enteric Reference Laboratory of the Public Health Laboratory Service. His name is well known through his association with the Weil-Felix reaction for the diagnosis of typhus fever during the First World War. In more recent years Dr Felix has established the value of this and similar reactions in the differentiation of rickettsioses throughout the world. He has also been responsible for work on the antigenic analysis of bacteria, in particular the recognition of the H, O and Vi antigens. This work has opened a chapter in serology and provided new methods of distinguishing closely-allied bacterial species and of dealing with problems of passive and active immunity. From 1927 to 1945 he was a member of the Scientific Staff of the

Lister Institute, London, and during the Second World War served as a specialist with the Emergency Public Health Laboratory Service. Dr Felix has numerous publications, amongst them an article in the Bulletin, on modern laboratory methods in the control of typhoid and paratyphoid-B fever (*Brit. med. Bull.* 1944, **2**, 269).

DR E. H. GILLESPIE is Director of the Public Health Laboratory at Leicester. He qualified M.B., Ch.B. at the University of Edinburgh in 1933, and has held appointments as assistant and Lecturer in the Department of Bacteriology, University College Hospital Medical School, London, as assistant bacteriologist, Public Health Laboratory, University of Manchester, and as bacteriologist to the Royal Berkshire Hospital, Reading. He has carried out research work on the pathogenicity of staphylococci, and from 1942 to 1944 served with the Emergency Public Health Laboratory Service, in charge of the Staphylococcal Reference Laboratory for the serological typing of staphylococci. His published work has included papers on the incidence of pathogenic staphylococci on the skin and in the nose, and on food-poisoning. Since 1946 he has been secretary of the Ice-Cream Subcommittee of the Public Health Laboratory Service, and has been responsible for the publication of its reports.

DR R. D. GRAY was educated at the University of Edinburgh, where he graduated M.B., Ch.B. in 1934 and M.D. in 1944. After three years' hospital appointments he entered the public health service in Essex and, taking the D.P.H. in London in 1938, became assistant to the bacteriologist to Essex County Council at the Counties Public Health Laboratories, London. While in charge of the Bacteriological Department there, Dr Gray made a detailed study of the bacteriology of water and contributed to that part of the 5th edition (1943) of Thresh, Beale & Suckling's *Examination of waters and water supplies*. After a short period in the Royal Army Medical Corps he re-entered the public health service, and eventually became Deputy County Medical Officer of Health in Gloucestershire. In 1948 he returned to laboratory work and is now Director of the Public Health Laboratory at Newport, Monmouthshire. He is a Fellow of the Society of Medical Officers of Health and is at present chairman of the Water Subcommittee of the Public Health Laboratory Service.

DR J. A. HARRINGTON is Assistant Medical Officer of Health to the County Borough of Ipswich. He was educated at Christ's College, Cambridge, and St. Thomas's Hospital, London. He served in the Royal Air Force as hygiene specialist from 1945 to 1947, and from 1948 to 1950 was an epidemiologist at the Central Public Health Laboratory. In 1950 he became secretary of a committee of the Medical Research Council which investigated the value of antihistamine in the treatment and prevention of the common cold.

DR BETTY C. HOBBS was educated at University College, London, and at the London School of Hygiene and Tropical Medicine. Her postgraduate studies have been devoted mainly to the bacteriology of milk, the isolation of intestinal pathogens, the serological classification of staphylococci and its relationship to staphylococcal infections and food-poisoning. More recently her work has been concerned with the bacteriology of foodstuffs, particularly those suspected to have caused food-poisoning, and with education in food hygiene. She has published a number of papers on these subjects in the *Monthly Bulletin of the Ministry of Health and the Public Health Laboratory Service*, and in other medical journals.

DR F. O. MACCALLUM has previously contributed to the Bulletin (*Brit. med. Bull.* 1943, **1**, 112) an article on infective hepatitis, with which a biographical note was published. From 1943 to 1946 he was working mainly on viral hepatitis. In 1946 he became Director of the Virus Reference Laboratory of the Public Health Laboratory Service, and since then has reported work on lymphocytic choriomeningitis, poliomyelitis, Q fever and smallpox.

DR JOHN MCCOY graduated M.B., B.Ch., B.A.O. in 1936 from Queen's University, Belfast, taking the D.P.H. in 1941. After holding house appointments in a general hospital he held in succession the posts of resident biochemist, bacteriologist, and serologist in the Royal Victoria Hospital, Belfast. Following service in the Royal Air Force from 1941 to 1946 he entered the Public Health Laboratory Service. With others he contributed the section on the bacteriological examination of water to the *Manual of British water supply practice* (ed. A. T. Hobbs, 1950).

DR A. M.-M. PAYNE was educated at Trinity College, Cambridge, and St. Bartholomew's Hospital, London, and is at present epidemiologist at the Public Health Laboratory, Oxford. He became interested in epidemiology during war service in India, where he was working on infective hepatitis, malaria and amoebiasis. Recent research has included work on the causes and epidemiology of infantile gastroenteritis; the epidemiology of streptococcal infections; the value of human gamma-globulin in the control of measles; and field trials of pertussis vaccines.

DR I. N. ORPWOOD PRICE is Director of the Medical Research Council's Venereal Diseases Reference Laboratory, London. His work has been principally on the cultural and serological diagnosis of venereal diseases, and he is vice-chairman of the Serological Subcommittee on Venereal Diseases of the World Health Organization. Dr Orpwood Price is assistant editor of the *British Journal of Venereal Diseases*, and has contributed to this and other medical journals; his monograph, *The complement fixation test for syphilis*, was published in 1935 by the London County Council.

DR R. W. RIDDELL is Director of Medical Mycology at the London School of Hygiene and Tropical Medicine and Lecturer to the Institute of Dermatology, St. John's Hospital for Diseases of the Skin. He has held posts of demonstrator in bacteriology in Edinburgh University, and Registrar in Pathology at St. Mary's Hospital, London. From 1939 until 1945 he served with the Royal Army Medical Corps as pathologist and, as Lieutenant-Colonel, was Assistant Director of Pathology to the Central Mediterranean Forces. In 1947 he undertook a study of mycotic diseases at the London School of Hygiene and Tropical Medicine, and in the following year was appointed to a Fellowship of the Commonwealth Fund of New York. In the USA, his work on mycotic diseases was continued, and shorter studies on histoplasmosis and coccidioidomycosis were made. He has written a section on histoplasmosis for the *British encyclopaedia of medical practice*, now in press (Butterworth), and papers have appeared in the *Lancet* and *Mycologia*.

DR JOAN TAYLOR was educated at University College and University College Hospital, London. She held various appointments in the pathological department of this hospital, including a special research appointment for the investigation of the bacterial causes of puerperal sepsis. In 1933 she was appointed Lecturer in Bacteriology in charge of the Department of Clinical Pathology at the Royal Free Hospital but was seconded to the Emergency Public Health Laboratory Service on the outbreak of war in 1939. She worked with the late Dr W. M. Scott on *Salmonella* identification until his death in 1941, and was appointed Director of the Salmonella Reference Laboratory in 1945. Dr Taylor has written on the laboratory diagnosis of enteric infections in *Recent advances in clinical pathology* (ed. Dyke, 1947), and has published papers on the identification of new *Salmonella* types. Her most recent work has been on the association of specific serological types of *Bact. coli* with infantile diarrhoea.

DR R. E. O. WILLIAMS contributed to the last number of the Bulletin an article entitled "Prevention of sepsis in industrial wounds" (*Brit. med. Bull.* 1950, **7**, 75), with which a biographical note was published. He is now Director of the Streptococcal and Staphylococcal Reference Laboratory, which includes an Air Hygiene Unit, at Colindale.

DR G. S. WILSON is Director of the Public Health Laboratory Service. He was educated at Epsom College and at King's College, London, and at Charing Cross Hospital, London. He graduated M.B., B.S. in 1916, M.D. in 1920, and was elected a Fellow of the Royal College of Physicians in 1930. After serving as a specialist in bacteriology in the Royal Army Medical Corps during the First World War, he re-joined the late Professor W. W. C. Topley at Charing Cross Hospital as demonstrator in bacteriology. He was appointed Lecturer in Bacteriology in the University of Manchester in 1923. He returned to London in 1927 as Reader in Bacteriology at the London School of Hygiene and Tropical Medicine and in 1930 became Professor of Bacteriology as applied to Hygiene—a post which he held till 1947. He was awarded the William Julius Mickle Fellowship of the University of London in 1939, and in 1942 the Weber-Parkes Prize of the Royal College of Physicians for his work on tuberculosis. At the outbreak of war he joined the Emergency Public Health Laboratory Service, succeeding the late Dr W. M. Scott as Director of the Service in 1941. Dr Wilson was appointed Honorary Physician to H.M. The King from 1942 to 1945. He is the author, with the late Professor Topley, of the 2nd edition of *Principles of bacteriology and immunity* (1936) and of the 3rd edition (1946) with A. A. Miles; of *The pasteurization of milk* (1942); and (jointly) of *The bacteriological grading of milk* (Medical Research Council Special Report Series No. 206, 1935), as well as of numerous scientific papers on growth of bacteria, the *Brucella* group, tuberculosis, and experimental epidemiology.

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ENGLISH PUBLIC HEALTH SINCE 1834

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The appearance of a book[1] of this kind is something of a literary event, for full-dress histories of English public health are few and far between. There has always been a fair output of monographs and collected essays on the subject and histories of all sorts carry chapters on public health. But we have to go back half a century, to Simon's classical account of *English sanitary institutions* (Cassell, London, 1890) to find anything comparable, in size, range and authoritativeness, to this book of Professor Frazer's.

The long gap in time between these publications is no gauge of the importance of the subject. In the history of social progress during the last hundred years the issues of public health are accepted as quite fundamental. In the history of local government it is the core of the business. In the advancement of medical science in certain important directions, sanitary questions have been the driving force. And, to refer to the significance of public health from an entirely different angle, there is no subject, with the possible exception of military strategy, in which the historical approach so usefully and directly points lessons for the future. Particularly for countries which are backward in sanitation the usefulness of English public health history is high. These are circumstances that social and economic historians have recognized and some of the most effective studies of certain aspects of public health history derive from the interest they have taken in the subject. But considered as a whole, so full is public health of inherent technicalities that its story, even in its more general social bearing, can never be more than half told by laymen. The onus of ensuring from generation to generation that full justice, historically speaking, is done to state medicine rests on the medical profession.

It is, of course, the interlocking of public health with so many other social factors that deters the medical historian from entering more frequently a field in which a professional background furnishes only part of the equipment needed for adequate treatment of the case. Professor Frazer, fortunately, seems as much at home with social and economic questions as with epidemiology, vital statistics and sanitary law. And it would be difficult to imagine a better balance than he keeps throughout his book between a foreground of pure public health matters and a background of contemporary social factors.

A difficulty of another kind confronts the author at the planning stage of a general history of public health—the choice between alternative methods of presentation. Public health is not a single entity but a fusion of administrative, clinical and scientific arts and practices: a piecemeal growth of main trunks and branches rooted in the idea of preventive medicine. In any strictly chronological unfolding of the subject as a whole the continuity of historical development of some of the component parts will be obscured by being scattered through the pages, to the chagrin of the specialist reader whose interests are restricted. If, on the other hand, the different branches are taken up and traced separately, the more catholic reader will never catch sight of the complete picture of the state of the community's health at any given period. Professor Frazer has chosen the chronological method: a sum total of comprehensiveness has been preferred to profoundness in particular directions. He carries the whole of public health forward on a broad front stage by stage through the half-dozen periods into which he subdivides his century of history. The arrangement is judicious. The transition from one stage to the next is smoothed each time by a brief prologue and such repetition as occurs is not repellent. The narrative ends at the outbreak of war in 1939, but the author has provided an epilogue with just enough contemporary history in it to bring the revolutionary social changes of the post-war period into perspective with the past. The final result is a splendid over-all picture, for which students and historians in other social fields will alike be grateful.

What will no doubt most astonish the reader who has not previously thought about the subject, and particularly the younger reader whose outlook is based on post-war experience, is to learn how much of the history of medicine and medical care is, with perfect propriety, included in a history of public health. As Osler pointed out, the foundations of modern medicine are contained in the annual reports on the state of the public health which Simon, the first medical officer of the Central Health Authority, and his successors in that office, prepared for the Privy Council (1859–71) and subsequently for the Local Government Board. Contrary to the popular view public health did not linger long as "a mere matter of sewers and drains": medical research was one of its earliest offspring. In recent times the outward structure of the public health services has been so heavily pruned that it is easy to lose sight of the pioneering field work and laboratory researches which these services formerly conducted on nutrition, on the etiology of the communicable diseases and in the discovery and filling of gaps in the provision of medical care generally. Though adding greatly to his own labour Professor Frazer has conscientiously pursued the history of all the principal by-products of the main sanitary movement. A more thorough exposition of the whole subject has never been published.

Shortage of sources of material for study is never likely to worry the author of a history of English public health. They abound—in the reports of various central departments, of government commissions and of local health authorities; and to counteract the heaviness of this official material there is an equal abundance of more discursive and intimate discussion of public health problems in biographies, in press files and in the records of the voluntary social services. No author can hope to examine more than a fraction of what is at his disposal. He must select, and in the process will determine the tone of his book.

Professor Frazer has cast his net widely, but he has perhaps leaned too heavily on official reports and on standard sources. He follows Simon closely in his treatment of the earlier phases in the sanitary reform movement. And though he

[1] For particulars, see p. 240.

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NEW TRENDS IN SOCIAL MEDICINE

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The number and variety of the articles and books now appearing on the subject of social medicine indicate that concerning the exact definition of this branch of medicine there is much confusion and much difference of opinion. Many present the view that it matters very little what those who profess social medicine regard as its content, aim and scope, since by the accumulation of knowledge in a variety of fields more detailed information concerning the role of socio-economic factors in the causation and therapy of disease will, as it becomes amassed, provide the definition that now dimly emerges from speculation. On the other hand, others even now wish to act upon the view that considerable knowledge concerning these matters is already in our possession and that what is now needed, and needed urgently, is action based on such knowledge.

It would seem that in the ultimate analysis such differences in point of view derive from two entirely different conceptions of what social medicine is or may become. Is it, or is it to become, a corpus of theoretical knowledge which, like that of pharmacology, for example, becomes available to the practitioners of medicine, or is it in fact a form of medical practice ? Is medicine itself a corpus of knowledge and a constellation of special techniques or is it the application of knowledge to human and social affairs ? In the opinion of the reviewer social medicine is not to be regarded solely as an academic discipline which equips the practitioners of medicine with greater understanding but also, like clinical medicine itself, as a form of medical knowledge in action which has for its purpose the preservation and augmentation of the health of the people.

If this be granted, then it falls to those engaged in the field of social medicine not only to add to knowledge and to offer advice but also to act, in the same sense as the practitioner of medicine acts. In action the essential difference between clinical medicine and social medicine is that the therapy of the latter must take the form of social and political action.

Among six recent books[1], in the titles of certain of which the terms " new " and " advances " appear, the difference referred to above is made manifest. These terms implicitly take it for granted that the subject has been defined and the authors therefore concern themselves with its development. Amongst these books, some content themselves with additions to existing knowledge or to refinements of existing techniques; others differ markedly in that they discuss the application of such knowledge in social therapy.

Historical Development of Social Medicine

The reviewer further approaches this matter with an understanding that social medicine has grown out of public health. If this be accepted, then a review of the evolution of public health from " medical police "[2], may help to find some answers to the more important questions that are now being asked concerning social medicine itself, and it may then become possible to assess the actual value of such terms as " new " and " advances ".

Public health, which was far more than a corpus of theoretical knowledge, was in the main the utilization of medical knowledge and skill as instruments of social policy in the affairs of a society. It grew as a response to the clamant needs of the population at a time when epidemics raged to disrupt social life and industrial production. The need for communal action for the prevention and control of epidemics was clearly recognized, but at that time the machinery of local administration was most imperfect and, moreover, many of the recommended actions based upon medical knowlege were of a kind that threatened to interfere considerably with the sphere of private enterprise. It can be accepted that for these and other reasons the major preoccupation of public health in its earliest days was restricted to the field of sanitation, for this did not interfere with the concerns of industry. It is noteworthy that what might quite properly be called public health measures for the regulation and improvement of conditions within the factories and mines met with much sterner opposition.

In brief then, the history of public health shows quite clearly that it has taken the form of general recommendations

[1] For particulars, see p. 240.
[2] See Roberton, J. (1809) *A treatise on medical police.* Edinburgh : Moir.

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rightly deplores the absence of any proper assessment of Edwin Chadwick's influence on public health he has not, alas, made the writing of this history an opportunity for bringing enlightenment. Until the unpublished Chadwick manuscripts[1] have been examined no history of " the great public health agitation " can be other than a qualified statement. Some of Professor Frazer's readers may feel that, in general, the author's interpretation of history is more conventional than vital and that his book lacks the verve that an exploration of newer sources would have given it. He has, however, performed a good service to his own profession in bringing to the fore material from the annual reports of the medical officers of health of a number of the larger local authorities. These local reports, like the unique series of reports of medical officers of health which he and his predecessors in office in Liverpool have produced, are perfect storehouses of information on bygone and current epidemiological theory and practice. So that it is in the various sections which deal with epidemiology that this outstanding book achieves its highest distinction.

[1] These unpublished papers were deposited in the Library of University College, London, at Chadwick's death.

directed toward the amelioration of the external world of those groups in the community which were unable to procure by their own means the necessary protection. Such recommendations were only implemented when they did not too seriously disturb the existing social and economic relationships, and when the improved conditions held out some promise of advantage to private enterprise.

Latterly public health has added to its interests, partly because the fields in which public health developed and which were unprofitable to private enterprise began to be dealt with in the form of routine (e.g. the Factory Acts and the Public Health Acts), and also partly because of the increasing recognition of the fact that conditions and circumstances within the social milieu were themselves causally related to ill-health within the population. In increasing measure public health began to focus its attention upon these socio-economic factors causally related to disease. It inherited from the older public health work and from the rapidly developing social sciences a vast amount of knowledge concerning the socio-economic factors which operate in the causation of disease. At the present time it is undoubtedly the case that the activities of academic social medicine and, to some extent, also social medicine in action in open society as exercised by medical officers of health, are largely expended in the search for a deeper understanding of the nature and magnitude of these socio-economic causes. But in open society the medical officer of health is much more than one who amasses more exact knowledge and offers more precise advice. He is required to take action. Attempted action of this kind must inevitably bring social medicine into the sphere of politics, for it is fairly obvious that if real advances in the further elevation of the public health are to come through the application of medical scientific knowledge relating to such matters as housing, town and country planning, industrial medicine, community nutrition and the like, they must bring social medicine into conflict with a great number and a wide variety of interests in which private enterprise and production for profit claim great importance.

Indeed it still remains to be seen whether or not, in a society such as our own with its existing structure and economic system, social medicine can in fact accomplish much simply by offering advice. It certainly can amass more accurate knowledge concerning faults in the structure and system which are themselves causally related to ill-health in the population, but it cannot translate knowledge into policy without coming into conflict with many interests. To the reviewer it would seem that the terms " new " and " advances" can only be applied in the field of social medicine when social medicine itself progresses beyond the quantitative stage of gathering knowledge and offering advice thereon and enters, as does clinical medicine, into the field of action, insisting in so far as it can that knowledge shall be translated into social policy. That is to say, the practitioners of medicine must express in action their opinion that the benefits of medicine should be enjoyed by all in a society in which considerations of human health and happiness overtop all others, particularly those which relate to the purely economic advantage of the few.

The Health of the People

These six books together indicate that what is really new in social medicine is still to come. The only one of them which approaches the subject of social medicine from the point of view of the general public and its needs is Leff's *The health of the people*. The author is a medical officer of health, that is to say a practitioner of social medicine, and a man of action. He recognizes very clearly indeed the socio-economic nature of the causation of social ill-health and considers the two main groups in society, the socially productive and the socially unproductive, in relation to the struggle for social amelioration. Furthermore, this book, quite unusual of its kind, considers always the effect of social change not only upon the individual but also upon the various socio-economic groups within society. It is divided into two parts: the first a historical review of the development of the health services in Britain, and the second a review of the present health services. In Part I the author describes the development of industry, the poverty and general social conditions that came to be associated with the rapidly expanding profit system, and the struggle for standards of living and health concomitant with the expansion of such enterprise. He shows that out of this struggle for better living standards there emerged spasmodic advances in public health in the fields of sanitation, factory legislation and the like, that each advance in public health came not as the result of medicine offering advice but out of actual conflict. In Part II the importance of each branch of the present health services is discussed, the present position being compared with the ideal; the difficulties that stand in the way of reaching that ideal are considered, and criticisms are offered concerning the present shortcomings of the National Health Service. Throughout this part there is a clear comparison between the stated role of the health services and the actual fulfilment of that role. In each chapter it is shown that there are vast differences between the health of the less well-to-do and that of the better-off; but, more than this, it is shown that in many an instance the present shortcomings are due to the fact that not only are the well-to-do not seriously interested in public health but that certain interests within the country definitely oppose developments in this field. In the concluding chapter the whole thesis of the book is summarized and it is shown that the opposition of vested interests has already made the National Health Service Act, 1946, a series of compromises; and that in the last two hundred years each step forward in public health was not an item in a planned policy but the outcome of some administrative or political crisis. In this book is to be encountered what the reviewer regards as the true approach in social medicine, a real attempt to identify the causation of social illness and not merely to treat its symptoms.

Social medicine has grown partly out of the knowledge of medicine applied to the individual and partly out of the social struggles for better living conditions on the part of a great mass of the common people. Clinical medicine could only treat symptoms until the causes and the epidemiology of the different diseases were understood. The precision of prevention and therapy of disease is predetermined by the accuracy of the understanding of etiology. So also until now social medicine has contented itself with studying the symptoms of social ill-health. Sometimes it has been suggested, rather tentatively, that the causes need to be attacked, but it is not usually agreed that it has become the responsibility of social medicine to engage in actual social therapy, that the causes of social sickness must when possible be removed and that real social therapy is not the provision of more hospitals and more medicine for more people but an enlarging participation in such matters as transport, schools, shops, parks, homes and

the like; that social medicine must prescribe for the group and must do everything in its power to ensure that its prescriptions are in fact dispensed.

Medicine and Mankind

Sorsby's book *Medicine and mankind* is different from that of Leff in the main ground that it covers and also in its initial approach. It represents a good and very clearly developed statement of the traditional approach to social medicine from a concept of individual health and of the need for unity between man, nature and the social milieu. The conclusion is reached that, for individual health, " individual " medicine is not enough. Health and disease are considered to be different aspects of the same phenomenon, being the results of balance and imbalance between the individual and his outer world. The chapters deal with health and with various types of disease, and lead on to therapy, firstly as applied to the individual and secondly by collective measures. In the last two chapters social achievements, social frustrations and future possibilities are considered and it is argued that whilst medical knowledge exists which, being applied, could eliminate a great deal of disease, such knowledge is not being applied over vast areas of the earth's surface. The environmental and social causes of this lack of application are considered. Emphasis is then placed upon the role of preventive medicine, its true meaning and its responsibility. This is a book which begins with traditional medicine and leads to public health and social medicine. The conclusions that are reached by its author are very similar indeed to those of Leff, though perhaps not so clearly formulated nor so deliberately directed to the betterment of social conditions.

Recent Advances in Social Medicine

Stevenson's *Recent advances in social medicine* is largely descriptive. It makes no attempt to define what social medicine is or may become, but deals largely with refinements of measurement and the more detailed description of the magnitude and nature of the causes of certain diseases of social importance. It is in many ways an excellent book for those already working in some fields of social medicine since it offers to them a critical evaluation of work carried out recently in a number of fields, such as infant and child welfare. Only in this sense can the book be regarded as dealing with " advances ".

Ecology of Health

Ecology of health deals with a number of papers presented at the Institute on Public Health held in connexion with the centennial celebrations of the New York Academy of Medicine. These papers deal with seven different aspects of public health and human ecology ; certain of these sections are of considerable interest, as for instance those on genetics and the public health, and on animal and insect reservoirs of disease. In general the papers presented fall into the category of the descriptive or else they deal with refinements in methodology. They relate mainly to the public health which preceded social medicine.

Derivations and Objectives

Social medicine: its derivations and objectives consists of reports of another series of papers read at a conference on social medicine in New York. This group of papers is also arranged round certain main topics, the first and most interesting being changing concepts of the relation of medicine to society. In this section Sigerist's paper entitled " From Bismarck to Beveridge " is very much worth studying, both for its discussion of the development and objectives of social medicine in the western countries and for the emphasis that the author places upon the significance of the development of the health services in the USSR. Ryle's paper on social pathology is of especial interest in that it is a testimony of the man who was mainly responsible in Great Britain for determining the direction of development of this subject as an academic discipline. In the other sections of this book the authors approach the subject from the angle of clinical medicine, seeming to suggest implicitly that studies in social medicine should concentrate on the individual. This is particularly so in those papers which deal with psychiatry. Such an attitude tends to negate the true approach of social medicine, since it concentrates its attention upon the individual and upon his reactions to the social milieu rather than upon the social nature of causation and the social responsibility of prevention. In general, the very wide variety of opinions expressed in this book perhaps shows the derivations of social medicine but hardly clarifies its objectives.

New Discoveries in Medicine

New discoveries in medicine: their effect on the public health differs entirely from all the rest in being openly retrogressive. It suggests that individual medicine is of more " spiritual " benefit than is a free health service which offers equal rights to all. According to the author, those who can well afford to pay for medical service are entitled to health, but those who cannot afford to pay must not be offered the means of achieving health freely, for if they are they cannot then appreciate it. This attitude is, of course, completely out of place in the field of social medicine. It is a principle that has been discarded in Great Britain long ago even by the majority of the privileged, no doubt partly for the reason that it became known that if disease is rampant among the underprivileged it might spread from the hovel to the mansion. This book not only attacks the basic ideas of social medicine, and in doing so appears to blame the poor for being sick, either physically or spiritually, but the author finds it desirable to disguise his attack upon social medicine by implying in his title that his subject-matter is that of social medicine. Such an assault upon the concepts of social medicine is perhaps to be welcomed for it indicates quite clearly that in the development of social medicine there will continue to be opposition from quite a number of quarters, not only within society as a whole but also within the profession of medicine. This book has peculiar value in that it shows very exactly what social medicine is not.

* * *

A study of these six books reveals, firstly, that the majority of their authors approach the theory of social medicine from the angle of the practice of individual medicine. Secondly, one of the authors (Hawley) evidences clearly that to advances in social medicine there is and will continue to be much opposition and much misunderstanding within the medical profession as a whole.

The most hopeful sign encountered in the reading of these books is that another medical officer of health, Leff, following

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MANSON'S TROPICAL DISEASES

Sir H. HAROLD SCOTT *K.C.M.G.* M.D. F.R.C.S. Ed.

A book which has to be re-issued every three or four years evidences its own usefulness and popularity, but does not call for a detailed analytical review as would a new production. It is, however, necessary to indicate the reasons which have necessitated a 13th edition[1] and to point out some of the advantages it possesses over its predecessors.

During the Second World War a large number of medical men served for the first time in the tropics and subtropics and there met with diseases new to them or types of diseases unfamiliar to them. As was only natural many of them rushed into print so that there might be permanent record of their " discoveries ". Some of this was helpful, but to those with longer experience in the practice of tropical medicine much of it was not new, and it needed a master mind to sift the grains of wheat from the bushel of chaff. This Sir Philip Manson-Bahr was ideally situated to do, having been engaged in the practice and study of tropical medicine for many years in many parts of the world. Again, the many thousands of men under discipline who were exposed to tropical infections afforded opportunities for those who had specialized in tropical research problems to put their theories and findings to the test of practice in the field. In revising a textbook which is recognized all over the world as authoritative it was necessary not only to evaluate the material resulting from conditions of war but also to consider developments which have led to the modification of older ideas. Comparison with previous editions affords abundant evidence of careful deliberation, for the latest edition, though embodying recent work, is only 66 pages longer than its predecessor.

The new arrangement of the introductory chapter is a great improvement. To deal with tropical climatology would call for undue allotment of space in a one-volume work on tropical diseases, and the essentials can better be embodied, as the editor has done, in chapters dealing with preparations for life in the tropics. Cosmopolitan diseases, that is those which occur in temperate as well as in tropical countries, also find a fitting place in introductory sections and differences in character can be pointed out. Anaemias of the tropics are now, and we think rightly, dealt with as a separate chapter. The section formerly entitled " Technique " has been recast and deals with special subjects, such as penicillin and DDT, and the section on laboratory methods, renamed " Clinical pathology ", is extended and rectifies an important omission, the care of microscopes and glassware. Lack of such knowledge has led to the ruin of many a valuable microscopic lens in the past. Few tropical general practitioners possess a laboratory or are capable of assessing the value of biochemical tests ; hence the wisdom of omitting biochemical examination of the blood and urine and the tests for atebrin, quinine, urobilin and such-like, to make room for more important clinical matters. Staining methods were given in previous editions, but as these are now carried out by specially qualified pathologists at properly equipped laboratories, they are omitted, as also is the agglutination procedure and the preparation of special culture media.

The new edition contains a chapter on fitness for tropical service. This has a threefold aspect : firstly, the determination of fitness of a candidate who has never been out of a temperate climate applying for a post in the tropics ; secondly, the decision which often falls to the lot of the harassed practitioner abroad as to whether a person living in the tropics is fit enough to continue there ; thirdly, it is not always easy to determine if a man who has broken down abroad and been sent home has become fit again to return. The previous edition contained a section dealing with the third aspect but since the question is decided by specialists at home there is justification for its omission. The " low fever " which is often seen in new arrivals and may persist for long periods is renamed climatic fever, but the cause still awaits elucidation.

The chapter on malaria has been re-arranged. The pathology of blackwater fever, formerly a subsection of the pathology of malaria, is now included more logically in the blackwater fever section, and the accounts of the haemolysis and anuria have been brought up to date. Newer drugs in the treatment of malaria are discussed and the vexed subject of treatment of malaria by drugs has been thoroughly revised. Therapeutic malaria receives special mention. A new illustration (fig. 220) is an excellent graphic representation of the complete life-cycle of the mammalian malaria parasite, based on the work of Shortt and Garnham ; succeeding it is another depicting the pre-erythrocytic stages.

The chapters dealing with trypanosomiasis and the leishmaniases are amplified and improved ; the penicillin treatment of Weil's disease is an addition and there is a good

[1] For particulars, see p. 240.

NEW TRENDS IN SOCIAL MEDICINE

Continued from page 216

the lead of Kershaw, has, in stating his creed, made it abundantly clear that he regrets not at all the ejection of the medical officer of health from the field of administration connected with the hospitalization and treatment of the sick. On the contrary, he sees in the opportunities provided by his position an invitation to apply the theories, the special knowledge and the methodology of social medicine in his service to the community for whose health he accepts responsibility.

What is new in social medicine and what constitutes an advance can perhaps be best summarized by a few quotations from Leff's book: " . . . science and society cannot advance until they have conquered disease, but that disease cannot be defeated until science and society advance. . . . The advance of science can be more rapid than the restricting influence of disease. . . . The application of science is, however, restricted by other influences." " . . . society cannot fight disease merely by improving the medical services. . . . Doctors must especially realize that a victory in the improvement of the medical services is a battle half won."

account of Haverhill fever and a most useful table contrasting it with the *Spirillum minus* type of rat-bite fever. Knowledge of the rickettsioses and of the various fevers of the typhus group has made large strides in recent years and has necessitated the fuller account which it now receives. Bullis fever ("Lone Star fever") and Colorado tick-fever have been removed from the typhus group. Q fever—Query fever, not Queensland fever, as is often thought—has been reported from various countries in Europe, and from America. Meningeal plague and the antibiotic treatment of plague receive more detailed mention. In the yellow fever section the list of transmitting arthropods and of animals which may be concerned is now very complete. The chapter on encephalitis has been mostly rewritten and enlarged. The fungoid form only of dhobie itch is mentioned, not the dhobie mark dermatitis from use of the nut of the bella gutti tree, *Semecarpus anacardium*. Tropical eosinophilia, unless different types of it occur in different places, should hardly be called a "local disease", since it is known to occur in China, the Philippines, Samoa, Ceylon, North, West and Central Africa and the USA. Some of the older, now discarded, remedies for ankylostomiasis have been omitted but a useful section has been inserted on the assessment of the results of treatment. Two important additions have been made to the vegetable poisons section, namely *Lolium temulentum* (flax darnel) and *Catha edulis*.

During the past two years the subject of the Rh factor has become very complicated, but the few remarks on it will probably suffice for the general practitioner in the tropics who need only know that there is such a thing and that it may constitute a risk in transfusion. In the previous edition penicillin received mention in several places as a means of treating amoebiasis, rat-bite fever, mite-borne typhus, etc.; now, like DDT and other insecticides, it is more fully dealt with in a chapter to itself.

There are two or three subjects which have been omitted from the present edition and which the reviewer, writing as a former tropical practitioner, would like to see restored. Notable among these are the tables of scales and standards, and the methods of preserving helminths and their ova. A medical man, far away from specialist and technical aid, may meet with a worm which is unknown to him. If he knows how to preserve it for despatch to the proper quarter for identification, much may be gained by the sender and the research worker. Many names are mentioned in the course of the book but references to the literature are not given. It would be a colossal task to add a bibliography at the end of the whole book, but a few references to the main sources might be given at the end of each chapter. Minor errors of syntax such as *Pasteurella tularense* and *Salmonella paratyphosum* are indications of a forgotten classical education and will doubtless be remedied in the 14th edition. So also may be the places of insertion of the plates which, excellent in themselves, seem to have been scattered promiscuously. For example, Terzi's beautiful pictures of *Glossina* precede the kala-azar plate, which itself faces photomicrographs of the brain in trypanosomiasis.

It would not be fair, however, to end, like the scorpion, with a sting in the tail. To sum up: almost every paragraph shows signs of careful thought and revision and special mention must be made of the new maps of distribution of African and American trypanosomiasis and of separate maps to show the distribution of yellow fever in Africa and in South America; another important addition is a map showing the world-distribution of sprue, particularly important in view of the many reports of sprue and sprue-like conditions which have been published since the end of the last war. Finally, the paper is better than in the last edition, the print clearer, and the illustrations have taken on new life. In the reviewer's opinion, the editor has carried out his Herculean task so successfully that "'Manson' still remains the best one-volume work on tropical medicine".

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Annotations & News

MEDICAL CONGRESSES 1951

Allergy. First International Congress of Allergists, 23-29 September 1951, Zurich. *Chairman*: Professor Charles W. Loeffler. *Secretary-General*: Professor A. S. Grumbach, Hygiene-Institut der Universität Zurich, Gloriastr. 32, Zurich

Anaesthesia. Twenty-sixth Annual Congress of Anaesthetists, 3–7 September 1951, London

Blood Transfusion. Fourth International Congress for Blood Transfusion, July 1951, Lisbon. *Chairman of the International Society*: Professor Tzanck, Centre national de transfusion sanguine, 6 rue Alexandre-Cabanel, Paris

Entomology. Ninth International Congress of Entomology, 17–24 August 1951, Amsterdam. *Chairman*: Professor D. J. Kusnen. *Secretary*: Dr J. de Wilde, Physiologisch Laboratorium, 136 Rapenburgerstraat, Amsterdam

Films. Fourth International Congress of Surgical and Medical Films, March 1951, London. *Director*: Mr Eric Duvivier, 3 rue de Siam, Paris 16e

Gynaecology. International Congress of Gynaecology, 23–29 June 1951, Paris. *Chairman*: Dr E. Douay. *Secretary-General*: Dr M. Fabre, 1 rue Jules-Lefebvre, Paris 9e

Hospitals. Second post-war congress of the International Hospital Federation, 15–21 July 1951, Brussels

Hydatidosis. Third International Congress of Hydatidosis, May 1951, Brazil

Industrial Medicine. Tenth International Congress of Industrial Medicine, 9–15 September 1951, Lisbon. *President*: Professor João Porto. *Chairman of the Organizing Committee*: Dr Alex. Ribeiro da Cunha. *Secretary*: Dr Luiz Guerreiro, Institut National Travail et Prévoyance, Service Relations intern., Praca do Comercio, Lisbon

Legal and Social Medicine. Third Congress under the auspices of the International Academy of Legal Medicine and of Social Medicine, September 1951, Paris. *Chairman*: Professor R. Piedelièvre. *Secretary*: Dr L. Dérobert, 2 place Mazas, Paris 12e

Mental Health. Fourth International Congress on Mental Health, 14–22 December 1951, Mexico City

Military Medicine. Thirteenth International Congress of Military Medicine and Pharmacy, 17–23 June 1951, Paris. *Chairman*: Médecin Général Inspecteur L. Jame, Direction Générale des Services de Santé des Armées, Ministère de la Guerre, Paris

Orthopaedic Surgery. Fifth International Congress of Orthopaedic Surgery and Traumatology, 21–25 May 1951, Stockholm. *Chairman*: Dr R. Scherb. *Secretary-General*: Dr J. Delchef. *Congress Secretariat*: Sten Friberg, Karolinska Instituts Ortopediska Klinik, Stockholm

Pathology. First International Congress of Clinical Pathology, 16–20 July 1951, London. *President*: Sir Lionel Whitby. *Secretary-Treasurer*: Dr W. H. McMenemey, Maida Vale Hospital for Nervous Diseases, London, W. 9

Conference of the International Society of Geographical Pathology, July 1951, Liège. *Chairman of the Belgian Committee*: Professor J. Firket, Institut de Pathologie, 1 rue des Bonnes-Villes, Liège, Belgium

Psychology. Thirteenth International Congress of Psychology, 16–21 July 1951, Stockholm. *President*: Professor David Katz, Psykologiska Institutet, Observatoriegatan 8, Stockholm

Reproduction and Artificial Insemination. Second International Congress of Physiopathology of Animal Reproduction and Artificial Insemination, Copenhagen. *Secretariat*: Via Bronzetti 17, Milan

Students. International Clinical Students Congress, 10 July–1 August 1951, Netherlands. *Secretariat*: Mr C. J. van der Kamp, Buiten Damsterdiep 62, Groningen

Surgery. Fourteenth Congress of the International Society of Surgery, 24–30 September 1951, Paris. *President*: Professor René Leriche. *Secretary*: Dr Louis Bazy, 12 rue de Seine, Paris

World Medical Association. General Assembly of the World Medical Association, August, Stockholm. *Secretary General*: Dr Louis H. Bauer, 2 East 103rd Street, New York 29, N.Y.

PRESIDENT OF THE ROYAL SOCIETY

At the 288th Anniversary Meeting held on 30 November 1950, Professor E. D. Adrian, *O.M.*, was elected President of the Royal Society.

Professor Adrian, who shared with Sir Charles Sherrington the Nobel Prize in Medicine in 1932, has been Professor of Physiology in the University of Cambridge since 1937. He is the ninth medical man to become President of the Royal Society. His own researches have dealt mainly with the properties of nerve fibres and with the central nervous system. The whole subject of encephalography, for example, rests almost entirely on his fundamental investigations. Professor Adrian is the author of numerous papers. For *British Medical Bulletin* (1945, **3**, 1) he wrote an article on physiological mechanisms in the brain, and more recently (1950, **6**, 330), he contributed to the symposium on neurophysiology. His election as President of the Royal Society will give great satisfaction to physiologists in all parts of the world.

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At the same meeting of the Royal Society, Sir Cyril Hinshelwood, Professor of Chemistry in the University of Oxford, was elected Foreign Secretary of the Society in succession to Professor Adrian.

MYCOLOGICAL REFERENCE LABORATORY

Dr R. W. Riddell, who contributes the article on fungus diseases in Britain to this number of the Bulletin, has now resigned his post as Director of the Mycological Reference Laboratory. Dr Jacqueline Walker has been appointed to act in his place.

PATENT MEDICINE ADVERTISING

For many years organized medical opinion has been distressed at the advertising of medicines and appliances in lay periodicals, by posters or in other ways. A Select Committee reporting in 1914 made recommendations for control of such advertisements and several abortive attempts at comprehensive legislation followed. In a more limited field—although dealing with important and serious diseases—laws have been passed to prohibit advertisements for products purporting to cure venereal disease or cancer, to procure abortion, or to cure a group of maladies which includes Bright's disease, cataract, diabetes, epilepsy, fits, glaucoma, locomotor ataxy, paralysis and tuberculosis. But what has been called the scandal of patent medicines continued to worry the medical profession and, in recent times, also the more reputable advertising bodies and newspapers. Hence an attempt has been made by representatives of newspaper publishers, by the professional bodies in the field of advertising and by the main association representing the proprietary medicine industry to draw up a "Code of Standards". The full title of this code, first issued in 1948 and brought out in a revised edition[1] in April 1950, is *British code of standards in relation*

[1] For particulars, see p. 240.

to the advertising of medicines and treatments. Thus the trade in patent medicines, and the newspapers which derive considerable revenue by advertising them, have jointly begun to clean up advertisements in this field. The general principles laid down are strict. The word " cure " is not allowed and advertisements are not to be accepted for diseases (including symptoms) " which should rightly receive the attention of a registered medical practitioner ". Such measures as diagnosis by correspondence, guarantees with offers of money back, the implication of " magic " or " natural " remedies, the use of misleading illustrations or testimonials are all prohibited. Section II of the Code summarizes the restrictions imposed by statute and Section III gives a list of " diseases, illnesses or conditions for which medicines, treatments, products or appliances may not be advertised ". This is too long and too comprehensive to be summarized here. Some of the terms used may be open to different interpretations. Otherwise it is difficult to understand why London's underground railways continue (over two years since the Code first appeared) to accept for display large advertising posters concerned with slimming. The introduction to the Code suggests that advances in medical science may lead to altered views and hence the Code will be subject to periodic revision. From the medical side there are doubtless many ways in which it might be strengthened but it is, even as it stands, a remarkable advance. Reputable firms and all but the worst kind of periodical have already shown a spirit of co-operation in working the Code which is reassuring.

A. M.

RECENT CHANGES IN THE INDEXES TO MEDICAL LITERATURE

Medical bibliography is a matter of concern to the entire medical profession and to the scientific world, for without adequate bibliographical guides and indexes medical literature would be overwhelming in its mass and complexity. Particular interest and importance attaches therefore to certain major decisions affecting the bibliography of the medical sciences which have been taken recently in the USA.[1]

Hitherto the literature of medicine has been better served by bibliographers than any other science. The *Index catalogue of the library of the Surgeon General's office*, which is the official catalogue of the Army Medical Library, is one of the greatest bibliographical tools ever compiled and has indeed been described as America's greatest contribution to medical knowledge. Coeval with the *Index catalogue*, and compiled on a similar grand scale, stand the *Index medicus* of the Army Medical Library and its successors the *Quarterly cumulative index* and the *Quarterly cumulative index medicus* of the American Medical Association. The 57 volumes of the *Index catalogue* contain more than 2,800,000 subject references, covering publications of the 15th to the 20th century. The *Quarterly cumulative index medicus* indexes some 1,200 of the more important current periodicals devoted to medicine and the allied sciences. Together, these indexes provide a bibliographical control over the early literature far beyond that enjoyed by any other science. Nevertheless, medical indexing never has been and never will be total. Some selection must be made. The Army Medical Library has (on cards) no less than 1,750,000 unpublished subject references, and 150,000 unpublished author entries for monographs. These figures give some idea of the arrears of entries which are inseparable from any index or catalogue appearing in the form of printed volumes arranged on an alphabetical or classified basis. This is the difficulty facing the compilers of the *Index catalogue* of the Army Medical Library. An even more urgent situation confronts the Army Medical Library in regard to the *Current list of medical literature* (see para. vi below) and the American Medical Association in so far as that body has been responsible for the production of the *Quarterly cumulative index medicus*.

The present crisis in indexing is due to the increasing difficulty of providing prompt information concerning *current* medical literature. The main factors in the creation of the present accumulation here are: (i) the receipt of huge quantities of unindexed publications from countries affected by the late war; (ii) an absolute increase in the number of medical and scientific periodicals since the war; (iii) the fact that an increasing number of articles of medical interest appear in journals devoted primarily to the non-medical sciences; and (iv) the pursuit by the Army Medical Library of an active policy of acquisition designed to fill all gaps in its collection.

Many of the difficulties confronting medical bibliographers are not new, but were fully appreciated by John Shaw Billings (1838–1913), principal founder of the Library of the Surgeon-General's office at Washington, and by his successors. Proposals for new and improved types of medical indexes have been made from time to time during the last 50 years; but it was not until July 1948 that a Committee of Consultants was established by the authorities of the Army Medical Library to undertake a systematic exploration of the use of, and need for, medical indexes. Recommendations made by this Committee were finally approved in 1950. The changes in the medical indexes which have taken place or are projected as a result of the recent decisions may be summarized as follows:

(i) The Army Medical Library will publish one more volume of the *Index catalogue* (Vol. XI, MH–MZ), and publication in the present form will then be discontinued.

(ii) It is proposed to publish a five-volume Supplement to the *Index catalogue*, each volume to contain approximately 1,400 pages. These volumes will list by author and subject monographs received up to 1950. At the present time there are in the Army Medical Library about 420,000 unpublished cards referring to material of this kind.

(iii) The Army Medical Library has established a new co-operative cataloguing agreement with the Library of Congress, under which the Army Medical Library will prepare catalogue cards for all titles for which Library of Congress cards are not already available. This material will be printed by the Library of Congress and sets of cards will be sold by its Card Division at a price of $100 per year. This programme is in continuation of the publication of the separate *Army Medical Library catalog cards* which were issued from April to December 1948.

(iv) From 1949 a further continuing record of the Library's holdings of monographs will be made by printing an annual *Army Medical Library author catalog*. This publication will be printed by the Library of Congress from the cards referred to above and will supplement, and be in a format similar to, the *Library of Congress author catalog*. The first volume, for 1949, containing approximately 23,000 main and added entries for monographs and serial titles, may be purchased from the Card Division, Library of Congress, Washington 25, D.C., for $12.50. This new annual volume will give the titles of all newly published medical works received in the Library during the preceding year, and will in addition contain entries for older works as these are re-catalogued. The successive volumes will therefore eventually provide a new printed author catalogue of the Army Medical Library.

(v) It is understood that some medium will be found for the publication of special bibliographical aids such as the list of medical and scientific Congresses prefixed to the C volume of the 4th Series of the *Index catalogue* and for such works as Dr Claudius F. Mayer's *Bio-bibliography of sixteenth century medical authors*, the serial publication of which was begun in the *Index catalogue*.

(vi) The *Current list of medical literature*, which appeared as a weekly publication from 1941 to June 1950, has been reconstructed and enlarged. The first issue of the new index, which retains the original title, appeared in July 1950. The new *Current list* will be published monthly. Each issue will consist of two parts: a register section in which medical journals are set out in alphabetical order and their contents listed seriatim; and an index section, consisting of author and subject headings also in alphabetical order. The monthly indexes will cumulate into annual volumes comprising entries for approximately 80,000 articles. The *Current list* will cover initially 1,225 selected journals and additions will be made periodically. An up-to-date list of the journals covered will be published annually. Of the 1,225 journals at present indexed, 43 per cent are in the English language. The titles of articles in foreign language journals will be given both in the original language and in English.

(vii) The *Current list* will not displace the *Quarterly cumulative index medicus*; it will provide a more up-to-date index of current medical literature. The two publications together will index nearly 2,000 journals. One-third of this total is covered by both indexes, and it is possible that there may be close collaboration between the two publications in future. Whether they will eventually be amalgamated to form a single comprehensive medical index will depend largely upon the experience gained by their use during the next few

[1] The greater part of the information given in this note has been derived from an authoritative and comprehensive article by Frank B. Rogers & Scott Adams on " The Army Medical Library's Publication Programme " (*Texas Reports on Biology and Medicine*, 1950, vol. 8, pages 271–300).

years. The *Quarterly cumulative index medicus* has had to face difficulties similar to those encountered by the *Index catalogue*. The latest published volume of the *Quarterly cumulative index medicus* (Vol. 44) covers the period July-December 1948. In order to bring the *Quarterly cumulative index* up to date as soon as possible the publication of Vol. 45 (January–June 1949) will be postponed until more recent volumes are completed. Vol. 46, covering the period July–December 1949, will appear as the next number, and because of a change in printing style it will have a different format. It is planned in the future to issue two volumes regularly in each year.

It must be emphasized that some of the changes outlined above are experimental and that various modifications may be dictated by the experience of those who have to use the indexes in their daily work.

W. J. Bishop

ADVICE ON SCIENTIFIC WRITING

When schoolboys are ordered to write an essay they are told that it must be " not less than 1,000 words." Without this stipulation, they would probably do the job in 500 or even in 200 words ; and perhaps they would learn to write better. It is a sad truth that much of our scientific writing suffers from the same inflation as is forced upon schoolboys, and thereby fails to convey thought and experience from writer to reader. Even the most earnest scientific worker now finds it hard to read all that he ought, and writers who wish to be read must not ignore this reality. The difficult art of catching, holding, and impressing a reader is well understood by those who write for newspapers. They know that if their headlines arrest attention and their first paragraph rouses interest the reader will continue ; they also know the loud rustle of a newspaper thrust aside because it has failed to compete against the many distractions of home life. The newspaper technique is often avoided by scientific intellectuals because they affect to despise the content of many articles in the popular press. This is a pity, because they would communicate their work far more effectively by imitating the good points of modern newspaper style rather than persistently using the bad features of the two-volume novel.

Happily, responsible persons are now concerned about the quality of scientific papers presented for publication and are doing what they can to improve matters. For example, the Royal Society has published a pamphlet of general notes[1] to supplement the specific instructions often issued by journals and publishers but not always followed by contributors. The Royal Society's pamphlet makes a good point in suggesting that it is wise to start drafting a paper while the work is still in progress so that attention may be drawn to experiments needed to complete the evidence. Another piece of good advice is to try several arrangements of tables or figures and to prepare these at an early stage and build the text around them. Willing but hurried readers, if they are not specialists in a subject, may still desire to know something about its progress ; and nothing is more useful to this class of reader than a helpful summary and tables or figures clearly intelligible without reference to the text. It is good counsel, also, to submit a draft to the beneficial influence of time and the comments of several candid friends not too familiar with the details of the work.

The notes contain excellent, detailed advice on the preparation of line drawings that will reproduce well and convey their message clearly. A reader of the pamphlet will hardly escape the feeling that its authors wish to convey what they are too polite to express : that prospective writers should look very closely at their material to decide if it has yet reached the stage when it deserves publication.

J. W. Howie

FIRST INTERNATIONAL CONGRESS OF INTERNAL MEDICINE

The First International Congress of Internal Medicine was held in Paris from 11 to 14 September 1950 under the chairmanship of Professor André Lemierre. With the aim of ensuring early publication and also of lightening the financial burden of the Congress, an arrangement was made with four well-known journals—*Acta Medica Scandinavica, British Medical Journal, Schweizerische Medizinische Wochenschrift* and *Semaine des Hôpitaux*—to publish the papers submitted. The *Semaine des Hôpitaux* has made a special effort in this connexion and produced a number (vol. 26, no. 65, 2 September 1950) of 412 pages entirely devoted to the Congress. Many papers, including most of those submitted by French authors, are published in full in French, with summaries in both French and English. Others, which are to be published in full elsewhere, are summarized or merely listed in the table of contents and marked with an asterisk. The papers are classified by subject, and the contents (also given in French and English) include all papers, whether printed here in full or not, which were received by the office of the Congress by 15 June 1950, and thus gives an over-all picture of the ground covered by the Congress. It is, however, to be regretted that there is no alphabetical list of authors—a usual and useful feature of reports of congresses.

All praise is due to those responsible, for supplying English summaries of the papers and an English version of the table of contents and for the work which has obviously been put into this. A few avoidable mistakes in translation (e.g. " ocular " for " auditif ") meet the eye, as well as some typographical errors (e.g. " the " for " they " and " antibiotic " for " antibiotics ") which might have been eliminated by more careful proof-reading. Nevertheless, the impression made by the whole number is excellent, and if the contributions of the other three collaborating journals to the report of this congress equal that of the *Semaine des Hôpitaux*, they will have done well.

A. H.-S.

THREE FRENCH MONOGRAPHS

As the note by Mr Bishop in the adjoining columns on recent changes in the indexes to medical literature implies, it is difficult enough to keep abreast of the immense mass of medical writing appearing in journals published regularly. How much more difficult it is to keep track of the large number of monographs published irregularly in many languages and on a wide variety of subjects. Very often these monographs contain the valuable results of years of work and observation : too often they tend to disappear into the limbo of the forgotten.

We should therefore like to draw attention to three monographs received from L'Expansion Scientifique Française in recent months. The first, *Les suppurations chroniques de l'oreille moyenne* by Dr Robert Maduro and colleagues, deals exhaustively in some 340 pages with the pathology, diagnosis and treatment of all forms of chronic otorrhoea. There are 33 figures, of which 28 are in halftone on art inset. Dr Maduro is otorhinolaryngologist to the Hôpitaux de Paris. The second is entitled *Le diabète sucré* and is by Professor Raoul Boulin of the Faculty of Medicine of Paris, with the assistance of Drs Uhry and Pierard. The third, *La lèpre*, is by Dr R. Chaussinand, Head of the Leprosy Service of the Institut Pasteur. It is extremely well produced and well printed on good paper, and—a rare thing in French publications—contains an adequate index to the contents. There is also an admirable bibliography of some 130 titles, and the text is illustrated by a series of 75 excellent photographs. The author and the publishers are to be congratulated on this excellent production.

* * *

From L'Expansion Scientifique Française we have also received *Le thermo-climatisme français* by C. Paulin ; and *Thérapeutiques cardiologiques internationales*, which contains the papers read at the 2nd and 3rd Semaines Cardiologiques Internationales de la Pitié, and is edited under the direction of Camille Lian, Professor of Clinical Medicine at the Hôpital de la Pitié.

NEW JOURNALS

The new journal, *British Journal of Delinquency*, is the official organ of the Institute for the Study and Treatment of Delinquency (ISTD). It has for some time been the desire of the Institute to publish a journal which would help to co-ordinate and consolidate scientific work on delinquency in all parts of the world. At last this ambition has been worthily realized ; vol. 1, no. 1 appeared in

[1] For particulars, see p. 240.

July 1950 and no. 2 in October, and both numbers are full of interesting material. The journal is of course not strictly a medical one, but it cannot fail to be of interest to psychiatrists and psychotherapists as well as to educational psychologists, sociologists, magistrates, probation officers, teachers, and all interested in the social problem of delinquency and in mental health. It is edited by Edward Glover, Hermann Mannheim and Emanuel Miller, and there is a distinguished editorial advisory board. It is the intention of the editors that " the articles published should be as representative as possible of work done in various lands". A glance at the list of contributions and at the short biographical notes on the authors shows that this intention has been amply fulfilled; there are articles from Philadelphia, Stockholm, Basle and Geneva, Utrecht, Amsterdam, Wakefield and London. In short, the journal is, if not in name, truly international in scope. Besides the half-dozen original articles which form the main part of each number, there are also critical book reviews, abstracts of relevant literature, and notes on international congresses on delinquency and allied subjects. An unusual and useful feature is a section of notes on current research in Britain; the editors hope that if workers will report their own work in progress, wasteful duplication of research will be avoided.

Our only criticism is the haphazard method of giving bibliographical references. Apparently each author has been allowed to adopt his own style and the result is no style at all. This is a pity in a journal that is clearly printed and of an agreeable format. The journal is published for the ISTD by Messrs Baillière, Tindall & Cox and costs £1 7s. 6d. (USA $4.00) per annum, or 7s. 6d. per single copy.

* * *

PAKISTAN

In October 1950 appeared vol. 1, no. 1 of *The Medicus*, a monthly journal devoted to medical sciences. It is published in Karachi, in English, under the editorship of Dr Muhammad Siddique Qureshi. Its aim is to tap the immense reservoir of clinical experience which must exist in Pakistan and to provide a channel for its publication; and at the same time to bring recent developments in medicine before general practitioners in Pakistan where, says the editor, " modern medical literature available to them is practically nil." To this end guest authors from Great Britain and North America are to be invited to contribute, and the journal also includes a short section of nine abstracts from the *British Medical Journal* and the *Journal of the International College of Surgeons*. One cannot help wondering if it is wise for an individual journal to attempt an abstracts section when abstracting services of world medicine are now readily available. The journal also contains a section on the history of medicine in which " Love as a medical problem " is discussed. This occupies three valuable pages and might well be omitted to make room for the discussion of more urgent medical problems. It is no doubt true that " a really good medical journal is greatly needed in Pakistan " and we hope *The Medicus* will soon find its feet and supply this long-felt want. We wish it every success.

* * *

ARGENTINA

We have received vol. 1, no. 1 (July 1950) of the *Gaceta Oto Laringológica Argentina*, the official organ of the Circulo Otorrinolaringológico of Rosario. This organization was founded on 20 April 1949, under the auspices of Dr Manuel González Loza, Professor of Clinical Otorhinolaryngology in the Faculty of Medical Science of Rosario, with the object of promoting the development of otorhinolaryngology and its associated specialties, and of encouraging the exchange of views between the otorhinolaryngologists of Argentina and those of other countries. The intended frequency of publication of the *Gaceta* is not indicated. This first number contains five main articles of a clinical nature, an obituary notice, short sections of news and notices of activities, and the act of foundation of the Circulo Otorrinolaringológico. Some of the main articles are of considerable length and all contain case reports, illustrated with well-produced half-tones. The journal is well printed on good paper, and the lay-out is clear and pleasing.

* * *

SPAIN

From Barcelona comes the first issue (vol. 1, no. 1, July 1950) of a new monthly journal, *Pro Infancia y Juventud*. It is published under the auspices of the Provincial Council for the Protection of Minors, Barcelona, and will be concerned with all problems affecting children and adolescents, particularly abandoned and delinquent children. This first number contains a long article on the education of protected children in institutions, some notes on medical care in infancy, a short description of Koch's " Baum-test " as a psychodiagnostic instrument, and a report by the chief inspector of primary education in Barcelona province on the needs of the 228,000 children under his jurisdiction. A page is devoted to reprinting the main clauses of the Charter of the Child, known as the Declaration of Geneva. The publication of this journal shows the growing realization in Spain, as elsewhere, of the importance to future generations of adequate child-care, physical, mental and spiritual. The editor of *Pro Infancia y Juventud* will be glad to receive communications from workers in child delinquency.

JOURNALS NEWLY RECEIVED

We have received vol. 4, no. 1 (1950) of *Recueil des Travaux de l'Institut National d'Hygiène* (Paris). This journal is divided into two sections: the first contains collected reports of the work done by the Institute, and the second is made up of original papers on work subsidized by grants from the Institute. In the first section are long articles on the practical possibilities in treating alcoholism, and on the results of the use of BCG vaccine. Among the original papers are contributions on some experimental work on the Bordet-Gengou bacillus, on DDT and various other insecticides, and on tetanus research.

Psyché (Paris) is a monthly international review for the study of man and psychoanalysis and is now in its fifth year. Vol. 5, no. 49 (November 1950) is a special number on dreams. It contains, first, a section of four main articles, which include a translation of some extracts concerning dreams from Valerius Maximus and an article on the dreams of negroes by a professor of the University of São Paulo. This is followed by a special section for " controversial questions ", in which, as stated in a footnote, the author has sole responsibility for the opinions expressed. The rest of the number includes a translation from the English of an article on industrial psychology by P. J. Dempsey, and there is a 32-page supplement consisting of part of a dictionary of psychoanalysis and psychological technique (*Dictionnaire de psychanalyse et de psychotechnique*).

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The following journals have also been received:

Academia Peruana de Cirugia (Lima), year 4, no. 6, 1950
Archivos del Hospital Universitario (Havana), vol. 2, no. 4, 1950
Indian Journal of Pharmacy (Bombay), vol. 12, nos. 1 & 2, 1950
Revista Cubana de Tuberculosis (Havana), years 12–13, April 1948–December 1949
Revue de Morpho-Physiologie Humaine (Paris), year 3, no. 5, 1950

Book Reviews

MEDICINE

The British Encyclopaedia of Medical Practice. Volume I. Abdominal Emergencies to Anus Diseases

Edited by *Horder*. Second edition. London : Butterworth & Co. Ltd., 1950. xxxi + 786 pages ; 148 figures. 25 × 17 cm. £3

(i) Abdominal emergencies ; (ii) abortion ; (iii) acanthosis nigricans ; (iv) accessory nasal sinuses ; (v) achalasia ; (vi) achlorhydria ; (vii) achondroplasia ; (viii) acidosis ; (ix) ackee poisoning ; (x) acne ; (xi) acromegaly ; (xii) acroparaesthesia ; (xiii) actinomycosis ; (xiv) actinotherapy ; (xv) adenoids ; (xvi) adiposity ; (xvii) adrenal gland diseases ; (xviii) aerophagy ; (xix) agranulocytosis ; (xx) ainhum ; (xxi) albinism ; (xxii) albuminuria ; (xxiii) alcoholism ; (xxiv) alkalosis ; (xxv) alkaptonuria ; (xxvi) allergy ; (xxvii) alopecia ; (xxviii) Alzheimer's disease ; (xxix) amenorrhoea ; (xxx) amoebiasis ; (xxxi) amputations, artificial limbs and appliances in industry ; (xxxii) amyloid disease ; (xxxiii) anaemia ; (xxxiv) anaesthesic trends ; (xxxv) aneurysm ; (xxxvi) angina pectoris and coronary occlusion ; (xxxvii) angio-keratoma ; (xxxviii) angioma ; (xxxix) anidrosis ; (xl) ankylostomiasis ; (xli) anorexia nervosa ; (xlii) antenatal care ; (xliii) anthrax ; (xliv) anus diseases. Index to Volume I.

In spite of the efforts of the publishers to keep this encyclopaedia up to date with annual supplements, the great advances in medicine in the last 15 years had made a 2nd edition overdue. For those who had not the pleasure of possessing or consulting the 1st edition, some explanation of the nature of the work is necessary. The encyclopaedia is suitable primarily for the general practitioner, particularly for the type of man who, because of his interest in medicine or by necessity, is in the habit of dealing unaided with a wide variety of conditions. In this work, he will find a guide to the treatment of all but the major surgical conditions ; indeed in some contributions, such as that on the paranasal sinuses, details of surgical technique are included. The contributors include some of the most distinguished names in British medicine, and the present volume alone contains the pith of a goodly number of expensive monographs.

Zachary Cope's article on the diagnosis of the acute abdomen and Gabriel's article on the anus should need no recommendation to medical readers. There is a very sensible article on adiposity, and an excellent one on alcoholism, in which the reviewer was glad to find a reference to that remarkable body, " Alcoholics Anonymous", formed in the USA in 1935 to help any alcoholic who applies for assistance. For the physician, there are good monographs on the anaemias, the adrenals, and a host of minor conditions, with a masterly contribution on angina pectoris. For the occasional anaesthetist, Frankis Evans summarizes the advances of the last 10 years. It is good to see some reference to limb-fitting after arm amputations ; the surgical textbooks are usually content to ignore the fate of amputees. For the obstetrician, there are detailed discussions on abortion and antenatal care. The dermatological specialists demonstrate the difficulty of curing acne and alopecia. There is one article whose title may baffle many experienced practitioners, though it makes very interesting reading ; this is the authoritative account of ackee poisoning by Sir Harold Scott. It is strange that detective fiction has ignored this undetectable poison.

The contents of this first volume demonstrate that the purchase of the encyclopaedia cannot fail to prove a sound investment.

S. S. B. Gilder

Emergencies in Medical Practice

Edited by *C. Allan Birch*. Second edition. Edinburgh : E. & S. Livingstone Ltd., 1950. xii + 564 pages ; 131 illustrations, 8 in full colour. 22 × 14 cm. £1 7s. 6d. [£1.375]

(i) The emergency bag ; (ii) acute poisoning ; (iii) the hazards of medical procedures ; (iv) acute (non-surgical) abdominal catastrophies ; (v) other (non-surgical) abdominal emergencies ; (vi) medical emergencies in obstetrics and gynaecology ; (vii) respiratory emergencies ; (viii) cardio-vascular emergencies ; (ix) emergencies in blood diseases ; (x) fits, faints and unconsciousness ; (xi) neurological emergencies ; (xii) psychiatric emergencies ; (xiii) medical emergencies in diabetes ; (xiv) medical emergencies in other endocrine disorders ; (xv) medical emergencies in renal disease ; (xvi) medical emergencies in infancy and childhood ; (xvii) emergencies in infectious fevers ; (xviii) emergencies in tropical medicine ; (xix) emergencies in industrial medicine ; (xx) medical emergencies at sea ; (xxi) medical emergencies in the air ; (xxii) ophthalmic emergencies ; (xxiii) emergencies in skin disease ; (xxiv) emergencies during anaesthesia ; (xxv) post-operative medical emergencies ; (xxvi) bites and stings and miscellaneous emergencies ; (xxvii) medico-legal and other non-clinical emergencies ; (xxviii) practical procedures. Appendix I : Vaccines, sera and anti-venines. Appendix II : Drugs mentioned in the text and their equivalent preparations. Index.

The appearance of the 2nd edition of this excellent and comprehensive book so soon after the publication of the 1st bears adequate testimony to its usefulness. Not only does this book incorporate the merits of the previous publication, which has been completely revised ; it is also 100 pages longer than the 1st edition. The addition of four new chapters, well written and illustrated, on skin diseases, eye injuries, and anaesthesia, together with that on post-operative conditions, has considerably enlarged the scope of the work, while the terminal chapter " Practical procedures " is a model of compression and conciseness.

Dr Birch and his collaborators have produced a most satisfactory vade-mecum for the harassed practitioner. In these times when so many complain of the need for attempting to cope with large numbers of patients, some such publication, with its clear exposition of emergency treatment lucidly put out and well expressed, seems to form an essential part of the practitioner's armamentarium.

The reviewer particularly liked Dr Birch's paragraph on iatrogenic emergencies at the end of Chapter III and the warning he gives that unwise thinking aloud by the practitioners, or the involuntary giving of clues to a patient on the discovery of serious disease, may itself precipitate an emergency. It is indeed a timely warning when so many seem to be trained to deal with diseases rather than with patients, for the fear of forgetting the human element in medicine should be ever before us. Dr Wilfred Oakley's chapter on diabetic emergencies, and that by Dr Rae Gilchrist on cardio-vascular emergencies, are particularly comprehensive. A surprising amount of space is given to the condition of Henoch's purpura, particularly as many authorities hardly consider it to be a disease sui generis, but rather an allergic or anaphylactic phenomenon.

The illustrations in this volume, on the whole, are clear and well documented, while some of the colour prints stand out most pleasingly. It is a book that can be thoroughly recommended, with confidence, to all concerned, both for the clarity of its print and clearness of its exposition.

R. Cove-Smith

Major Symptoms in Clinical Medicine. Volume I

John Almeyda. London : Henry Kimpton, 1950. xiii + 378 pages ; 185 illustrations. 25 × 16 cm. £1 5s. [£1.25]

(i) Introduction ; (ii) objective symptoms ; (iii) respiratory symptoms ; (iv) cardio-vascular symptoms ; (v) alimentary tract symptoms ; (vi) urinary symptoms. Index.

It is of prime importance that a book on clinical medicine and its practical application should be crystal clear, its illustrations telling their story even without sub-titles, the classifications and tables self-evident, the text lucid and never ambiguous. It cannot be said that this volume satisfies any of the above criteria. Even the title carries confusion. Accepting the definition of a " symptom " found in *Stedman's medical dictionary*—" any morbid phenomenon or departure from the normal in function, appearance or sensation, experienced by the patient and indicative of disease "—Dr Almeyda notes that symptoms can be subjective or objective and devotes many chapters to physical signs, which he calls objective symptoms.

The same confusion of thought and lack of lucidity is apparent throughout the book, even in the different tables of classification. There is hardly a page which does not convey a half-truth or worse. On p. 50, in the list of conditions causing " generalised pigmentation of brown or brown-black " one reads that Cushing's syndrome is diagnosed " by the plethoric appearance, the transverse blue striation of the abdominal vessels . . . and the presence of 17-ketosteroids in the urine." (And, of course, a brown-black discoloration of the skin.) One begins to wonder which are typist's errors and which author's.

The classifications are cast so broadly that they are frequently confusing. Under the chapter heading " Facies " (p. 72), the classification of acute conditions reads :

> Physiological. Fear, anxiety, shock, shyness.
> Pathological. Pneumonia, erysipelas, measles, scarlet fever, mumps, tetanus, trichiniasis.

What benefit is to be derived from such a tabulation ? If one turns to the explanatory notes on the next page, it is to read that all

above four states listed under " physiological " are diagnosed " by the expression of querulousness."

Finally, there is little excuse for the black-and-white drawings that illustrate these pages. They would have been out of date 25 years ago. Who would care to diagnose the type of sore throat from the illustrations on pages 131 to 134? Many of the photographs are equally bad. If figs. 69, 65, and a dozen others really reveal the characteristics of the diseases they are meant to demonstrate there is little hope that most of us will ever understand medicine. Why touched-up photographs, such as fig. 19, are shown is a mystery. The last 20 years of progress in medical illustration have passed by this particular publication. It is not a book that can be recommended as a guide to the undergraduate or graduate in medicine.

F. Dudley Hart

Clinical Examination of Patients, with Notes on Laboratory Diagnosis

John Forbes & W. N. Mann. London : Edward Arnold & Co., 1950. x + 323 pages ; 4 plates ; 60 figures. 22 ×14 cm. 18s. [£0.9]

(i) Introduction ; (ii) history-taking ; (iii) general physical examination ; (iv) the skin ; (v) the cardiovascular system ; (vi) the respiratory system ; (vii) the alimentary system ; (viii) the genito-urinary system ; (ix) the central nervous system ; (x) abnormal psychological states ; (xi) the eye ; (xii) the ear, the nose and the throat ; (xiii) bones, joints and muscles ; (xiv) laboratory investigations ; (xv) diagnosis. Index.

This book sets out in some three hundred pages the points to be noted on clinical examination, and the techniques to be adopted for their elicitation. It takes all of the space to do this, and no attempt is made to raise fine points of differential diagnosis. The book is throughout a very practical one, written particularly for the medical student commencing his work in the wards.

It goes without saying that this subject is one best taught at the bedside and in the clinic ; one clinical demonstration by a good teacher would present the point with far more force and clarity than could the reading of any book on the subject, however clear and well written. What this volume does is to present the facts, the " bare bones " of the subject, which can be read parallel with bedside instruction. Sections on *x*-ray findings, electrocardiographic tracings, and biochemical and other laboratory investigations, are a useful addition. However one may emphasize the prime importance of the bedside approach, in these days such investigations are a routine part of examination, and of " clinical " medicine.

This is an excellent book, and one to be warmly recommended to the medical student as an introduction to his work at the bedside.

F. Dudley Hart

X-Ray Diagnosis : For Clinical Students and Practitioners

G. Simon. Cambridge : W. Heffer & Sons Ltd., 1949. x + 207 pages ; 180 illustrations. 25 × 19 cm. £1

(i) Introduction to diagnostic radiology ; (ii) radiology in bone and joint diseases ; (iii) radiology of the abdomen ; (iv) radiology of the chest ; (v) radiology of the head and neck ; (vi) miscellaneous. Index.

This book is produced primarily to give recently qualified practitioners and medical students an insight into the essentials of diagnostic radiology. There is no doubt that it adequately fulfils this function (especially for the junior house officer) and one might go further and describe it as a useful reference book for the more established clinician. The correlation of clinical and radiological findings has been successfully achieved and little of a controversial nature is included. The arrangement of the book into sections dealing with regions of the body, with sub-headings in heavier type and good spacing of paragraphs, makes for easy reading and rapid reference.

In a volume of a little over 200 pages it is obvious that only a brief outline of radiological and clinical features can be given. In the main, this has been well accomplished, though one might criticize the fact that 3½ pages are occupied by a description and illustrations of kymography, whereas angiocardiography is not more than mentioned. The reader is not confused by long descriptions of a multiplicity of methods of radiological investigation. The methods described (though there will be some radiologists who may cavil at a few of them) are, for the most part, those which have stood the test of time and, though many of the descriptions given are not sufficiently full to enable the reader to carry out the procedures, such detail is not necessary (and, indeed, might be wearisome) for anyone who is not a practising radiologist.

In the section on radiology of the chest, space might have been found for a brief description of the radiographic location of the lobes and fissures in postero-anterior and lateral views—often a source of difficulty for the beginner. Amongst the various methods of performing bronchography it is refreshing to see the nose-drip method given, though the student is not told that passing a nasal catheter till its tip is seen in the oral pharynx is of considerable assistance in this procedure. One would have thought that the cricothyroid route would have been mentioned only to be condemned.

Barium meal technique is described briefly, but clearly, and the importance of studying the mucosal pattern is given its rightful place, as is the necessity of examining the patient lying down as well as in the erect position.

In his description of spondylolisthesis (incorrectly spelt in the text) Dr Simon seems to imply that the displacement is a posterior one of the first sacral segment, rather than to give the more usually held view that it is a slipping forward of the fifth lumbar on the superior surface of the sacrum.

The printing is clear and on good quality paper. The book is profusely illustrated and most the of reproductions of skiagrams show the lesions plainly, though some of those of bone conditions are hardly up to a high standard. The absence of a bibliography is a drawback, but not such a serious one as in a more advanced textbook. At 20 shillings the volume is purchasable even by the impecunious medical student or house officer and he can rest assured that his money will be well spent.

G. A. Macdonald

Aviation Medicine : its Theory and Application

Kenneth G. Bergin. Bristol : John Wright & Sons Ltd., 1949. xv + 447 pages ; 130 figures. 22 × 15 cm. £1 15s. [£1.75]

Part I. Introduction. Part II. Physiological considerations. Part III. Medical considerations. Part IV. Psychological considerations. Part V. Preventive health. Part VI. Appendixes. Index.

Medicine has been hard put to satisfy the demands that the advances in aviation have made upon it. No sooner had the problems of altitude been studied, and methods devised to counter them, than the effects of acceleration and of increase in gravity had to be overcome. Now, with jet-propelled aircraft in daily use, teams of physiologists have to work on the problems of sound and supraSonic speed : and new problems continue to arise. There have been very few physiologists and clinicians with special knowledge to meet these problems. Dr Bergin is one of those few : he has studied medicine in relation to aviation throughout his career, first in the Volunteer Reserve of the Royal Air Force throughout the war, and then as a senior medical officer in the British Overseas Airways Corporation. In this textbook he has done his best to bring together what was learnt about the effects of wartime flying upon the human body and mind, and his application of this knowledge to the conditions of civilian aviation.

Many of the problems of wartime are not encountered in peace, because the demands made upon the body by acceleration can be avoided and the disastrous effects of excessive hazard are not usually seen. There are, however, many basic problems, which simply consist of the application of elementary physiology to special circumstances which are common to both acceleration and hazard. Dr Bergin has handled these subjects clearly in the section of the book entitled " Physiological considerations ", and has illustrated them with charts and pictures from many sources.

Part III of the book is devoted to medical considerations. Here again each chapter constitutes an introduction to the subject, and each has its useful list of references for those who wish to seek authority. Dr Bergin has found difficulty in incorporating data and illustrations (which he has taken en bloc from official reports and technical journals) within his more elementary exposition in such a way that they do not obtrude but simply provide evidence for his thesis. Because of this, many of his chapters seem to contain diverse hard facts loosely joined by the continuo of his text. The section of seven chapters dealing with psychological considerations is in effect a précis of the reports on the psychological problems of aircrews encountered in the Royal Air Force in the past war, with a few additional references. The chapters therefore deal with flying in special circumstances and necessarily present an ad hoc

explanation of the psychiatric problems which were experienced at that time.

This is the first new textbook on aviation medicine to appear since the war and Dr Bergin must be congratulated on the diverse sources he has explored. Medical officers who are entering this field will find it a useful introduction and to many others it will be interesting and stimulating.

Denis Williams

A New Approach to the Treatment of Burns and Scalds

Leonard Colebrook. London: Fine Technical Publications, 1950. 174 pages; 9 figures; 1 chart. 22 × 14 cm. 12s. 6d. [£0.625]

(i) Introduction; (ii) the need for Burns Centres; (iii) the planning of a Burns Centre; (iv) the lay-out of the Centre; (v) staffing; (vi) the technique of wound dressing in the Burns Centre; (vii) the treatment of the burned patient; (viii) a plan for burns in the event of another war. Conclusions. References. Appendix I, II & III. Index.

This new monograph is a most important contribution to medical progress. The book is carefully laid out, clearly written and well illustrated and it places in true perspective the importance of injuries from burns in an industrial community. The author's conclusions are applicable to most conditions of life today.

Dr Colebrook lays down a well-defined policy for the care of burn injuries based on his extensive experience in charge of the Burns Unit at the Glasgow Royal Infirmary during the years 1942–44, and of the Medical Research Council Burns Unit at the Birmingham Accident Hospital from 1944 to 1948. He contrasts the management of a case of severe burns under ideal circumstances, as in Birmingham, with that usually practised in general hospitals today. He shows how the total elimination of infection even from extensive burns can be made a practical proposition. By the correct use of plasma to replace fluid loss and by the elimination of infection he reduced the mortality to 2.7 per cent in a series of 490 cases severe enough to be admitted: a notable achievement.

He has shown that infection is responsible for most of the misery following on burns; its prevention allows more rapid healing, earlier skin-grafting and reduces the stay in hospital.

A strong case is made out for the provision of Burns Centres and the criticisms that may be levelled against them are answered; a chapter is devoted to the lay-out and equipping of a centre and a detailed plan is included at the back of the book. It is stated that patients must be segregated to prevent the spread of infection and the cubicle system is advised. There is convincing evidence of the need to maintain bacteria-free air in the dressing-station, and an air filtration plant is described which changes the air 20 times an hour thus maintaining a constant temperature and humidity. There is valuable information on the detection of air contamination and early wound infection, the haemolytic streptococcus being the greatest enemy. A dressing technique is described which has been thoroughly tried and might well become standard.

The importance of correctly staffing a centre is appreciated and a chapter is set aside to deal with the problems involved. For 60 beds the author advises one senior surgeon with experience in plastic surgery, two junior surgeons and two house surgeons. The bacteriologist plays a vital part in the work of a unit, and first-class bacteriological facilities are essential.

A valuable appendix has been added, which contains an article by Bourdillon & Colebrook, "Air hygiene in dressing rooms for burns, or major wounds" reprinted from the *Lancet* (1946, **1**, 561); this describes in greater detail than does the main text the experimental work carried out in Glasgow and Birmingham. The Bourdillon slit-sampler has made it possible to assay and compare air contamination under varied conditions with an accuracy not previously attained. These results have the greatest practical significance. There are also further statistics and diagrams and a complete index of the book.

Unfortunately, the demand for increasing all hospital services is so great that it will be some time before special centres can be built on the lines advocated, but much can be done to mitigate the problems of the treatment of burns by applying the principles to existing conditions. So thorough has been the work on which this book is based that the principles laid down in it will be as relevant in 25 years' time as they are today. It should be read by every medical student and practitioner and by every surgeon; it is already finding a place in the training of nurses, and should be brought to the notice of all who are planning our hospitals of the future.

D. C. Bodenham

Modern Practice in Dermatology, 1950

Edited by *G. B. Mitchell-Heggs.* London: Butterworth & Co. Ltd., 1950. xxv + 836 pages; 319 figures; 7 colour plates. 25 × 17 cm. £3 3s. [£3.15]

(i) The structure, anatomy, physiology, pathology and function of the skin; (ii) history and examination of a patient, with notes on diagnosis; (iii) general principles of treatment; (iv) common congenital disorders of the skin; (v) benign and malignant new growths; (vi) diseases due to physical causes; (vii) exogenic dermatitis; (viii) industrial dermatitis, with special reference to prevention, recurrence and prognosis; (ix) allergy in diseases of the skin; (x) eczema; (xi) rosacea, including seborrhoea oleosa, acne vulgaris and hyperidrosis; (xii) seborrhoeic dermatitis; (xiii) pityriasis rosea; (xiv) psoriasis; (xv) pyogenic affections of the skin; (xvi) impetigo; (xvii) virus diseases; (xviii) syphilis; (xix) tuberculosis and sarcoidosis of the skin; (xx) fungus infections of the skin; (xxi) animal diseases transmissible to man; (xxii) scabies and pediculosis; (xxiii) arthropods in relation to skin disease; (xxiv) drug eruptions; (xxv) toxic eruptions; (xxvi) lupus erythematosus; (xxvii) bullous eruptions: dermatitis herpetiformis and pemphigus; (xxviii) psychosomatic disorders; (xxix) lichen planus and the lichenoid eruptions; (xxx) diseases due to circulatory disorders; (xxxi) chilblains; (xxxii) the reticuloses and Kaposi's sarcoma; (xxxiii) the sclerodermias; (xxxiv) skin diseases of warm climates, and cutaneous manifestations of malnutrition; (xxxv) dermatoses caused by protozoal, bacterial and virus infections; (xxxvi) non-communicable dermatoses especially common in warm climates; (xxxvii) diseases of the skin affecting the mucous membranes; (xxxviii) cancer of the mucous membrane; (xxxix) disorders of the scalp; (xl) disorders of the skin affecting the nails; (xli) disorders of the skin with ocular involvement; (xlii) disorders of the skin mainly affecting the hands and feet; (xliii) disorders of the ano-genital region; (xliv) eruptions in the napkin area; (xlv) disorders of the skin associated with avitaminosis; (xlvi) cutaneous manifestations of general disease; (xlvii) biopsy: its indications and technique; (xlviii) physiotherapy and radiotherapy in dermatological conditions; (xlix) the pharmaceutical aspect; (l) social aspects of dermatology. Index.

It is usual nowadays for large textbooks for specialists to be written by many authors. This practice is less common in books for general practitioners. The authors chosen by an editor are usually men of comparable standing. This book is peculiar in that its 41 authors include some of the most senior and most junior dermatologists with many at various levels in between. The editor is to be congratulated on the generally high standard of the contributions.

The book opens with a masterly foreword by Lord Horder. Instead of the few meaningless platitudes often found in forewords, this is a short essay well worth reading by all. In his preface, the editor notes that repetitions occur in the book; in some cases they are excessive, as when an excellent chapter on pyogenic affections is followed by one on impetigo.

The whole range of dermatology is covered, the practical and the academic being well blended. Throughout, the writing is clear, and in the chapter on psychosomatic disorders it is brilliant. Tropical dermatoses are treated fully. Unusual chapters which will be found useful and interesting deal with animal diseases transmissible to man and disorders of the skin with ocular involvement.

The outstanding chapter is on exogenic dermatitis. Others that are uncommonly good are those concerned with seborrhoeic dermatitis and the biopsy. There is one very strange chapter heading: "Rosacea, including seborrhoea oleosa, acne vulgaris and hyperidrosis"!

The teaching is generally sound. No dermatologist will agree with every detail in any book. The only two points likely to cause eyebrows to be raised are the recommendation to use mikraform sulphathiazole in impetigo and the suggestion that lichen planus is but little influenced by treatment. Two unfortunate choices of terminology should be corrected in the next edition: "intradermal" should be replaced by "intracutaneous", and "erythema serpens" ought at least to be given as a synonym of "erysipeloid" or could replace it.

This book is so good that a 2nd edition is sure to be needed. A few suggestions may, therefore, not be out of place. The chapter on diseases due to physical agents should mention urticaria. A reference could advantageously be made to the work of Storck, perhaps in the chapter on allergy. The chapter on toxic eruptions is a little below the general high standard and could be rewritten with benefit. The chapter on arthropods might well be shortened. These are all minor criticisms.

The production of this volume is of the finest: the 319 black-and-white illustrations are well chosen and admirably reproduced, and there are seven colour plates; the index is good. This work can be recommended with confidence.

E. Lipman Cohen

A Text-Book of Venereal Diseases

R. R. Willcox. London : William Heinemann Medical Books Ltd., 1950. 439 pages ; 7 plates ; 154 figures. 22 × 15 cm. £1 12s. 6d. [£1.625]

Part I. (i) Venereal diseases and anatomy ; (ii) diagnosis of gonorrhoea ; (iii) gonorrhoea in the male ; (iv) complications of gonorrhoea in the male ; (v) gonorrhoea in the female ; (vi) gonorrhoea in the child ; (vii) non-gonococcal discharges in the male ; (viii) non-gonococcal discharges in the female. Part II. (ix) Diagnosis of syphilis ; (x) early acquired syphilis. I. Primary syphilis ; (xi) early acquired syphilis. II. Secondary syphilis and relapsing syphilis ; (xii) treatment of early acquired syphilis ; (xiii) latent syphilis and late syphilis of the skin and mucous membranes ; (xiv) late osseous and late visceral syphilis ; (xv) cardiovascular syphilis ; (xvi) neurosyphilis ; (xvii) congenital syphilis ; (xviii) prognosis of syphilis ; (xix) yaws and other diseases resembling syphilis ; (xx) chancroid, lymphogranuloma venereum and granuloma inguinale ; (xxi) other conditions commonly encountered in venereal diseases clinics. Part III. (xxii) The sulphonamides ; (xxiii) the antibiotics ; (xxiv) the arsenicals ; (xxv) bismuth, mercury and iodides ; (xxvi) prophylaxis and venereal diseases control ; (xxvii) details of technique. Index.

Writing for the express purpose of covering the needs of venereologists abroad, as well as in Great Britain, Dr Willcox has presented the reader with a mine of information. Indeed, for its size, it is probably the most concise work in venereology produced, so far, in Britain.

While, however, it will amply cover the needs of the student and general practitioner alike, it does not always measure up to the standards demanded of such a book by a consultant in venereology. Excluded from these remarks is that section dealing with non-gonococcal urethritis, which probably takes second place only to the classical work written more recently by Harkness. Dr Willcox gives adequate space to this subject which may well rapidly replace gonorrhoea in its importance in the venereal diseases department.

Nothing but praise can be awarded to the author for his emphasis on some of the errors occurring in the diagnosis of gonorrhoea. The futility of the vaginal smear in the adult patient and the need for differential staining are but two of the points rightly emphasized. Also to be commended is his condemnation, for obvious reasons, of oral penicillin as an anti-gonorrhoeal measure.

At the expense of omitting prophylactic treatment as practised in the First World War, and condensing those sections devoted to the arsenical preparations and the sulphonamides, especially the latter, space could have been given to the social aspects of the venereal diseases problem. It might be claimed that no modern work is complete without at least one chapter on this vitally important branch of venereology since contact-tracing and case-holding have done much to prevent dissemination of the disease and, we hope, will prevent many patients suffering needlessly from the effects of syphilis in later life. The value of the contact-tracers' efforts, rather than the "contact slip or letter" must be realized if the sexually promiscuous are to be traced and their diseases eradicated.

The subject of syphilis is, in the main, adequately covered. Perhaps more detailed discussion on the differential diagnosis of the secondary cutaneous phases of the disease and, likewise, the tabulation of the major points differentiating the tertiary lesion, especially from neoplasm and tuberculosis of, for example, the tongue and the testicle, would have been helpful. To condense such a vast subject as syphilis is, however, exceedingly difficult.

While all authorities, especially in the USA, report favourably on the treatment of syphilis with penicillin alone, one would hesitate to label such results with other than the term "tentative cure." We still await results one hundred per cent successful after such therapy in those suffering from the sero-positive contagious variety. Nor must we condemn tryparsamide entirely since, brilliant though the penicillin results may be, some patients, especially those suffering from neuro-parenchymatous manifestations, benefit from subsequent courses of this drug in conjunction with bismuth.

Both author and publisher are to be complimented on a publication, presented in an attractive style, which will prove a decided acquisition to the medical practitioner's library.

W. V. Macfarlane

Hay-Fever : a Key to the Allergic Disorders

John Freeman. London : William Heinemann Medical Books Ltd., 1950. xx + 321 pages ; 71 figures ; frontispiece. 25 × 19 cm. £2 2s. [£2.1]

(i) Hay-fever itself ; (ii) on the relationship between hay-fever and all other toxic idiopathies ; (iii) causation in general . . . (iv) the idiotoxic cause . . . (v) idioceptor : the allergic sensitivity . . . (vi) prophylactic thoroughgoing desensitisation (P.T.D.) by self-inoculation . . . (vii) 'Cause D.' Serous leak ; (viii) trauma : tissue damage the localising factor ; (ix) emotions, moods and tensions ; (x) home influence ; (xi) further considerations of emotion . . . (xii) Cause G : the bacterial factor ; (xiii) exercises in phylactology ; (xiv) vaccines and pathophanes for the toxic idiopathics ; (xv) specificity of idiotoxic antigens. Appendix. Index.

The work of Blackley in the 1870's on the etiology of hay-fever and that of the author's friend, Leonard Noon, is amply acknowledged in this notable book. Their pioneer work has been fulfilled by the establishment of the hay-fever clinics at St. Mary's Hospital by Dr Freeman.

Unlike most books on allergy, which have often hundreds of references and even more, this book has none ; the reason for this is that when, some forty years ago, Dr Freeman started his investigations, no bibliography on the subject existed. For the same reason he uses his own nomenclature. "Toxic idiopathies" takes the place of "sensitization to foreign proteins", "atopens" and the more crude and recently publicized "allergy". This terminology may prove a difficulty to those who know only their own accepted English or American synonyms.

Where the author's views differ from those of other writers, however general the acceptance of the views of the latter may be, he does not hesitate to say so, even to admitting such a heresy (to the ordinary allergist) as to doubt the value of house dust as an antigen to which all patients must be tested ; however, he gives his reasons. The "fallacy of the single cause" is stressed. Seven main causes of allergy are considered : each cause is dealt with in a separate chapter, the discussion being fully supported by evidence. The author's treatment of the bacterial factor is naturally of great interest. In few books on allergy are the importance of gut sepsis and the necessity of small doses of vaccines in treatment so correctly emphasized as in the present volume. The finest chapters are those dealing with psychological factors, e.g. Chapter IX, entitled "Emotions, moods and tensions."

The wealth of experience of thousands of hospital and private cases which the author has drawn on, fully illustrated with anecdotes, makes this book excellent reading ; it is based on a philosophy from which every medical man, be he in embryo or fully fledged, would gain. The book contains many shafts of humour through which the blunt John Freeman appears on every page.

Frank Coke

Lipidoses : Diseases of the Cellular Lipid Metabolism

Siegfried J. Thannhauser. Second edition. Edited by *Henry A. Christian.* New York : Oxford University Press, 1950. 605 pages ; 125 figures. [Reprinted from Oxford Loose-Leaf Medicine with the same page numbers as in that work.] 24 × 16 cm. £4 16s. [£4.8]

(i) The physiology and chemistry of lipid metabolism ; (ii) hyperlipemia ; (iii) xanthomatoses ; (iv) Gaucher's disease (reticular and histiocytic cerebrosidosis) ; (v) Niemann-Pick's disease (reticular and histiocytic sphingomyelinosis). Supplement A. Infantile amaurotic idiocy. Supplement B. Hurler-Pfaundler syndrome (gargoylism). Bibliographies. Index.

This 2nd edition of Thannhauser's *Lipidoses*, originally published as part of the "Oxford Loose-Leaf Medicine", remains the storehouse of all the knowledge accumulated about disordered cellular lipid metabolism in man. Great as this knowledge is, it still awaits future work to establish the fundamental basis and etiology of most of the lipidoses, as their investigation has scarcely yet progressed beyond the stage of collecting data. It is in no way a reflection on the eminent author that the picture of most of the diseases presented is still a static one, although a serious attempt has been made, whenever possible, to bring the concept of lipidoses in harmony with the idea of the dynamic state of body constituents as revealed by the researches of the last two decades.

Although fundamentally there is little change in the book compared with its 1st edition, certain chapters have been rewritten or broadened and the whole text reset in a larger type than the 1st edition. Xanthomatous biliary cirrhosis has been separated from the syndrome of essential xanthomatoses of the hypercholesterolaemic type and also Schüller-Christian disease has been designated "eosinophilic xanthomatous granuloma" because of its characteristic histological features. A section on the adult form of Niemann-Pick disease and a chapter on the Hurler-Pfaundler syndrome (gargoylism) have been added, although the latter, on the basis of the analytical figures shown, does not appear to be a disease of cellular lipid metabolism.

In spite of the great merits of this monograph, which brings together all the information available on lipidoses, there is much that

will offend the reader. It is a real disappointment to read the chapter on the physiology and chemistry of lipids, in which only a narrow view is given of modern concepts of fat metabolism. The intermediary metabolism of fatty acids is dealt with in 3½ pages, which also include a hurried presentation of the tricarboxylic acid cycle. Even allowing that the primary aim of the work was to describe the diseases of cellular lipid metabolism, this chapter is still inadequate and the exposition of β-oxidation of fatty acids (incidentally, called " Knoopis rule " !) misleading. One gains the impression from this chapter that ketone-bodies (e.g. acetoacetic acid) might be derived directly from the oxidation of fatty acids. The experimental evidence of recent years has, however, shown that fatty acids are first broken down to C_2 units (to acetate or an active derivative of it) which then recondense to form acetoacetic acid. One might have also expected greater attention to correct chemical nomenclature. There are several errors in this respect, some of which may be pointed out: " di-carbonic acid " for dicarboxylic acid; " carbonyl group " for carboxyl group; " tricarbonylic acid cycle " for tricarboxylic acid cycle, etc. It is also erroneous to speak of animal and vegetable cholesterols, as there is but one cholesterol of a definite chemical structure obtained from animals. It is therefore totally misleading to say that Macleod & Smedley-Maclean have shown that yeast cells can synthesize cholesterol from acetate; yeast produces ergosterol and not cholesterol. Enough has been said to indicate that some of the statements in the book have to be taken with reserve.

A further offending feature is the vast number of typographical errors found on almost every page. One does not know whom to blame for these—the author, editor or publishers? There are far too many mistakes of this kind to enumerate, but here is a typical example: legend to fig. 73 [on p. 214 (361)]: " Tumerous form of xanthoma disseminata (corinophilic xanthomatous granuloma of skin) . . . ", etc. for: Tuberous form of xanthoma disseminatum (eosinophilic xanthomatous granuloma of skin) . . . etc. Surely it is not pedantic to ask that the gender of classical terms be observed or that the spelling of authors' names, their initials, the titles of their papers (since the publishers chose to give the full titles of the papers in the bibliography) and the journals be correctly quoted? The reputation of the publishers is by no means enhanced by offering to the medical reader a volume for £4 16s. which appears to be hardly beyond the stage of press proofs.

G. Popják

Old Age: Some Practical Points in Geriatrics and Gerontology

Trevor H. Howell. Second edition. London: H. K. Lewis & Co. Ltd., 1950. vii + 108 pages; 9 illustrations. 21 × 14 cm. 10s. 6d. [£0.525]

(i) Approach to old age; (ii) care, comfort and management; (iii) temperature in old age; (iv) pulse rate in old age; (v) the haemoglobin level in old age; (vi) arterial thickening in old age; (vii) senile deterioration of the central nervous system; (viii) rheumatic disease; (ix) chronic bronchitis; (x) the cardiovascular system in old age; (xi) progressive cerebral ischaemia; (xii) the kidney in old age; (xiii) geriatric rehabilitation; (xiv) incidence of cancer; (xv) disease in old age; (xvi) some clinical signs; (xvii) morbid anatomy of old age; (xviii) the A.B.C. of geriatrics. Index.

When the author of this useful book began his investigations at the Royal Hospital[1], Chelsea, little was known and less was recorded of many phenomena of old age. By careful clinical observation he elicited several important facts: to mention only a few, he found that in the apparently healthy aged the range of " normal " temperatures is increased, there is great variation in the pulse rate but no tendency to anaemia, the pupils often fail to react, the ankle jerks are frequently lost and absence of vibration sense in the legs is common.

Despite their difference from the physiological pattern of youth and maturity, the author considers that the aged may be deemed healthy if they can enjoy life of moderate activity, and that is reasonable in the present state of knowledge, although the future may well reveal pathological lesions responsible for the changes he has observed. His work on arterial thickening is particularly interesting, because he found that of 25 men from 66 to 91 years of age, who all had severe atheroma, no less than 12 were " relatively healthy and able to get about in comfort." Clearly the condition of the " old " does not depend only on the state of their arteries.

[1] A hospital in London for army pensioners.—ED.

The chapters on the treatment of the common maladies of later life—rheumatic disease, chronic bronchitis, cardiac failure and cancer—are well done. The author's experience of the injection of procaine lactic acid into " rheumatoid joints " has not been uniformly happy.

These essays are a challenge and a stimulus; they show the extent of our ignorance of a problem that urgently concerns western civilization and they prove how much may be learned by patient study and sustained clinical interest. Dr Howell's pioneer work has of necessity been largely restricted to patients in the hospitals with which he is connected and these are a sample representing no more than 5 per cent of the aged. What is now required are similar investigations of the condition of those who remain in the common stream of social life and seek no refuge in institutions. [Cf. J. H. Sheldon, *The social medicine of old age* (1948), reviewed in *Brit. med. Bull.* 1949, **6**, 115.—ED.]

A. P. Thomson

Law Relating to Hospitals and Kindred Institutions (Incorporating " Law for Nurses ")

S. R. Speller. Second edition. London: H. K. Lewis & Co. Ltd., 1949. xliii + 587 pages. 22 × 14 cm. £2 2s. [£2.1]

(i) Hospitals—definition and classification; (ii) state hospitals; (iii) hospitals administered under the National Health Service Act, 1946; (iv) voluntary hospital authorities; (v) Charitable trustees and the Charity Commissioners; (vi) provision of pay beds; (vii) consents to operations and kindred matters; (viii) injuries to patients and others; (ix) detention of patient against his will; (x) persons of unsound mind and mental defectives; (xi) loss of or damage to patient's property; (xii) births and deaths in hospital; (xiii) professional confidence and cognate matters; (xiv) ownership of medical records; (xv) poisons and dangerous drugs and radioactive substances; (xvi) professional qualifications; (xvii) law of master and servant as affecting hospital staff; (xviii) statutory regulation of conditions of employment; (xix) hospital rates, taxes and duties; (xx) raising money for hospitals; (xxi) gifts by will to hospitals; (xxii) hospital charges; (xxiii) nuisance and trespassers; (xxiv) search and arrest of suspected persons; (xxv) the nurse's contractual position; (xxvi) nursing homes and agencies for the supply of nurses; (xxvii) National Health Service Act, 1946; (xxviii) the Public Health Act, 1936, and the Public Health (London) Act, 1936. Bibliography. Appendix A, B, C, D, E. Index.

Two years after Speller's *Law relating to hospitals and kindred institutions* made its first appearance we have a very much extended and very much more complete 2nd edition, with an addition of no less than 182 pages. The 28 chapters cover a very wide field indicated by the title of the work. The advent of the National Health Service Act, 1946, necessitated the rewriting of a substantial part of this book, and much new matter, notably Statutory Instruments under that Act, has been included.

The new legislation dealt with includes the Penicillin Act, 1947, and the Radioactive Substances Act, 1948. Chapters on contracts and on the sale of goods, included in the first edition, have been omitted to make room for some of the additional material. The chapters on master and servant and on the Factories Acts have been retained for those concerned with hospital management.

The National Health Service Act, 1946, naturally enjoys an important position in this book, and the chapter which deals with it is divided into parts as far as possible corresponding with the " Parts " of the Act.

It is not possible to touch in detail upon the vast array of important topics which the author has authoritatively treated, but suffice it to say that here is a book where extensive and valuable information not readily accessible elsewhere is made available to the reader. Such matters as consent to operations, accident cases, emergency patients, infants in law, mental patients, artificial insemination, illegal operations and operations likely to cause sterility in married women, together with general principles for deciding liability for injury, are considered. Subjects which also receive attention are: detention of patients against their will, and their remedies for this; loss of, or damage to, patients' property; births and deaths in hospitals; ownership of medical records; gifts by will to hospitals; search and arrest of suspected persons; the nurse's contractual position, and nursing homes and agencies for the supply of nurses.

The index to cases cited, the indexes in connexion with the Table of Statutes and Statutory Instruments, and the general index are in each instance both adequate and well arranged.

I can confidently recommend this book to all whose interests lie directly, or indirectly, with hospitals and kindred institutions.

John Glaister

SURGERY

Modern Trends in Orthopaedics

Edited by *Harry Platt*. London: Butterworth & Co. Ltd., 1950. viii + 497 pages; 222 figures. 25 × 17 cm. £2 5s. [£2.25]

(i) The evolution and scope of modern orthopaedics; (ii) fracture treatment; (iii) tuberculosis of bones and joints; (iv) pyogenic affections of joints and bones; (v) congenital dislocation of the hip; (vi) congenital deformities of the spine and limbs; (vii) chronic arthritis; (viii) skeleton, joint and muscle tumours; (ix) scoliosis; (x) paralysis; (xi) injuries and derangements of the spinal column; (xii) injuries of muscles and tendons; (xiii) certain vascular lesions; (xiv) the bone dystrophies. Index.

This book, edited by Sir Harry Platt and with 13 contributors, all well-known British orthopaedic surgeons, has attempted to describe present trends in certain fields of orthopaedic surgery. In this it has only partially succeeded; however, some of its successes are notable.

Osmond-Clarke provides a short but very excellent summary of present-day views on scoliosis. The treatment of this condition has changed notably in recent years, largely owing to American efforts, and recognition of this change is overdue in British literature. Osmond-Clarke has shown clearly the simple principles involved in correction and fusion and does much to make a complicated subject easy to understand. No reservations need be made in calling this contribution excellent.

Furlong has summarized well the views of both Bunnell and Pulvertaft on the subject of the repair of flexor tendons in the hand. A sensible compromise between the two methods has been reached, based on the author's own considerable experience. There is so much more new work to be discussed in the reconstructive surgery of the hand that it is a pity we are not allowed to have more. There are few branches of orthopaedic surgery in which greater advances have been made in recent years.

Norman Capener presents a concise review of the treatment of various types of arthritis, a difficult subject to attempt, but in this case undertaken very successfully. The subject is dealt with logically and with a most sensible evaluation of the methods available. This chapter is deservedly included in *Modern trends*.

In one of the major chapters of the book, "Bone dystrophies", Jackson Burrows brings sense into a chaotic field. In a branch of orthopaedics where there is still much elementary knowledge lacking and where there is great confusion because of the resulting vast nomenclature, we find ourselves well rewarded for reading a chapter solidly packed with information.

There are several other contributors whose efforts merit discussion, did not space forbid. Two contributions, however, do merit some criticism because it is difficult to justify their inclusion in a book called *Modern trends*. Girdlestone has produced an excellent article on long-established methods in the treatment of tuberculosis, but rightly or wrongly the present trend is away from these. In view of this it would have been more helpful to have discussed chemotherapy and earlier operation at greater length since these are the present controversial aspects of this subject. M. Forrester-Brown, in a somewhat confused article on poliomyelitis, has not dealt with the methods of treatment adopted in most clinics. Prolonged immobilization and great caution in using weak muscles is a method long used but one that does not stand up to detailed analysis. Earlier usage very rarely causes deterioration in muscle gradings and it has many advantages. In the treatment of the hand, there are many more reconstructive procedures available than are discussed.

The book is not a credit to the publishers and some of the diagrams are so ill reproduced as to be useless; nevertheless, the book is well worth buying—and reading.

J. I. P. James

Operative Surgery, by Various Authors

Edited by *Alexander Miles* & *James Learmonth*. Third edition. London: Geoffrey Cumberlege, 1950. x + 559 pages; 235 figures. 22 × 14 cm. £1 10s. [£1.5]

(i) Choice of anaesthetic; (ii) operations on blood-vessels; (iii) operations on peripheral nerves; (iv) operations on lymph glands; (v) operations on bones; (vi) operations on joints; (vii) operations on muscles and tendons; (viii) orthopaedic operations on the extremities; (ix) plastic surgery; (x) amputations; (xi) operations on the scalp; (xii) operations on the face, mouth, and tongue; (xiii) operations on the jaws; (xiv) operations on the cranial air sinuses; (xv) operations on the neck; (xvi) operations on the thyroid gland; (xvii) operations on the pharynx and oesophagus; (xviii) operations on the air-passages; (xix) operations on the chest; (xx) operations on the breast; (xxi) general technique of abdominal surgery; (xxii) operations on the stomach and duodenum; (xxiii) operations on the liver, the gall-bladder, and the bile ducts; (xxiv) operations on the pancreas; (xxv) operations on the intestines; (xxvi) operations on the vermiform appendix; (xxvii) operations on the rectum; (xxviii) operations for hernia; (xxix) operations on the spleen; (xxx) operations on the kidney and ureter; (xxxi) operations on the bladder; (xxxii) operations on the urethra; (xxxiii) operations on the male genital organs. Index.

There are many works on operative surgery available for the advanced student but none is so compendious nor so reasonably priced as this one. The editors have attempted to collect in a most compact book a comprehensive though not detailed account of operative surgery as practised by the Edinburgh School. A large number of contributors have been called upon for the various chapters and it is surprising to find the presentation so uniform with such multiple authorship. An account of the surgery of the central nervous system has been omitted because, say the editors, an adequate description of the diagnostic and operative technique employed in a modern neurosurgical clinic would be beyond the needs of the general surgeon, and, if not complete, a description might be misleading. It is true that the demand for specialization in surgery becomes more insistent every year, but such a book as this might well resist the tendency. Certainly the explanation given is not entirely adequate, for many peculiarly complicated operations in so-called general surgery are treated briefly. For example, the surgery of portal hypertension is dismissed in a few lines and such a formidable undertaking as pancreatectomy is not described in any detail.

Despite these defects, the book contains a wealth of information presented in a lucid manner. It is difficult to pick out individual chapters for praise and it is natural to turn first to those subjects in which the reader has a special interest. The chapter on thyroid surgery is comprehensive, clear and well illustrated; there is, however, an error on p. 251 where the caption describing ligation of the superior thyroid artery refers in fact to the inferior thyroid artery.

In a few places, operations which have been almost entirely abandoned are described, perhaps because their description is considered necessary for examination purposes. Otherwise the illustrated description of oesophago-gastrostomy on p. 268 should be mentioned only to be condemned, for this procedure leads to symptoms more intractable than those it is designed to cure. The treatment of congenital tracheo-oesophageal fistula gives perhaps undue stress to the multiple stage methods and not enough to the direct anastomosis so successfully carried out by Haight and Swenson in the USA and by Franklin in England.

There is a most satisfactory essay, by John Bruce, on the general technique of abdominal surgery, with an admirable account of postoperative complications and their management. Sir James Learmonth contributes a well-balanced account of the surgery of peripheral nerves and of the sympathetic nervous system. The biliary system is treated in masterly style by Professor Aird, the text being extremely well illustrated by black-and-white drawings. Operations upon the thorax have been given rather more space than those on the other parts of the body; this is probably in keeping with the rapid growth of this specialty.

This is a well-balanced though rather brief work on operative surgery. It contains sufficient information to carry any student through his final Fellowship examination in surgery and at the same time might prove a useful reference work to the house surgeon. It is well printed on good paper and generously provided with illustrations of a high order.

Selwyn Taylor

British Surgical Practice. Volume 8

Under the general editorship of *Ernest Rock Carling* & *James Paterson Ross*. London: Butterworth & Co. Ltd., 1950. xxi + 597 + 33 pages; 264 illustrations; 9 plates. 25 × 17 cm. £3

(i) Spleen—surgery of; (ii) sterility and sterilization; (iii) sterilization of surgical apparatus; (iv) stomach—diseases of; (v) strabismus and heterophoria; (vi) subphrenic abscess; (vii) supraspinatus lesions; (viii) surgical technique; (ix) surgical technique—wound dressings; (x) syphilis; (xi) tabes dorsalis (locomotor ataxia); (xii) testicle and tunica vaginalis; (xiii) tetanus; (xiv) tetany; (xv) thoracic and intrathoracic injuries; (xvi) thrombosis and embolism; (xvii) thymus gland; (xviii) thyroglossal cyst, sinus and fistula; (xix) thyroid gland—diseases of; (xx) tonsillitis; (xxi) tropical disease—surgery in; (xxii) tuberculosis; (xxiii) typhoid fever, surgery in; (xxiv) ulcers and ulceration; (xxv) umbilicus—diseases of; (xxvi) uraemia; (xxvii) ureter—transplantation

of; (xxviii) urethra and bladder: congenital malformations; (xxix) urethra—new growths and stricture; (xxx) urinary antiseptics; (xxxi) uterus—fibroids; (xxxii) uterus—carcinoma of the body; (xxxiii) uterus—cervix; and vagina; (xxxiv) uveal tract; (xxxv) vascular surgery; (xxxvi) veins—varicose; (xxxvii) visceroptosis; (xxxviii) visual fields—perimetry and interpretation; (xxxix) vitamins and nutrition in relation to surgery; (xl) vitreous—injuries and diseases; (xli) volvulus; (xlii) yaws. Index to Volume 8.

The last volume of *British surgical practice* starts with an article on the surgery of the spleen and concludes with a section on yaws. The contributions reach a high standard and it is difficult to discriminate but we believe all would agree that the 40 pages devoted to vascular surgery (written by Gordon Murray of Toronto) is a particularly illuminating account of the wonderful recent developments in that branch of surgery. As one would expect, the article on the surgery of the thymus by Geoffrey Keynes is clear, concise and authoritative, and the section on diseases of the thyroid (by the late Sir Alan Newton) crowds a surprising amount of information into small compass. The whole volume is well illustrated and produced and it is a joy to read.

Since this is the concluding volume of the series we would like to add a general commendation of this encyclopaedia of surgery. The editors and the publishers deserve the thanks of the English-speaking surgical world for presenting in such a favourable form the most up-to-date information on every aspect of surgery. Though primarily intended for general practitioners (and for them it is almost a necessity) it contains much information which will be useful for the surgical specialist and for the consulting physician. The lay-out is excellent, the type good and clear, the illustrations so numerous and apt that both the mind and the eye are equally satisfied and gratified. There has probably never been any British surgical publication which could compare with this work both as regards the distinction of the contributors and the excellence of the matter. We cordially wish it a great success.

V. Zachary Cope

Emergency Surgery. Parts I, II & III

Hamilton Bailey. Sixth edition. Bristol: John Wright & Sons Ltd., Part I, 1948; Part II, 1948; Part III, 1950. vi + 556 pages; 859 figures. 25 × 16 cm. £1 1s. [£1.05] per part

Part I. (i) Cannulization for infusion and transfusion; (ii) the principles and practice of continuous intravenous (including intramedullary) infusions; (iii) replenishing the circulating body fluids (*continued*): alternative methods; (iv) blood transfusion; (v) the treatment of shock, and other methods of resuscitation; (vi) anaesthesia for urgent operations; (vii) impending death under anaesthesia; (viii) armamentarium; (ix) laparotomy; (x) burst abdomen; (xi) the abdominal wall and the extraperitoneal tissue space; (xii) drainage of the peritoneal cavity, the retroperitoneal spaces, and the abdominal wall; (xiii) peritonitis; (xiv) acute appendicitis; (xv) late acute appendicitis; (xvi) acute salpingitis; (xvii) some other conditions simulating acute appendicitis; (xviii) gastric, duodenal, and intestinal aspiration; (xix) ileostomy and jejunostomy. Part II. (xx) Perforated gastric and duodenal ulcers; (xxi) haematemesis and melaena; (xxii) the stomach (*continued*); (xxiii) the gall-bladder and bile-ducts; (xxiv) acute pancreatitis; (xxv) other emergency conditions in the upper abdomen; (xxvi) foreign bodies in the food-passages; (xxvii) intra-abdominal injuries; (xxviii) penetrating wounds of the abdomen; (xxix) resection of gut; (xxx) treatment of acute intestinal obstruction: general principles: classification; (xxxi) obstruction of the large gut; (xxxii) obstruction of the small gut: special varieties; (xxxiii) intestinal obstruction in the newborn; (xxxiv) acute intussusception; (xxxv) strangulated external hernia; (xxxvi) strangulated femoral hernia; (xxxvii) strangulated umbilical and incisional herniae: exomphalos. Part III. (xxxviii) The rectum and anus; (xxxix) the female generative organs; (xl) some emergencies in obstetric practice requiring surgical measures; (xli) abdominal emergencies in the tropics; (xlii) some post-operative complications; (xliii) faecal fistulae; (xliv) phlebothrombosis decubiti; (xlv) renal colic and acute renal infections; (xlvi) injuries to the kidney and ureter; (xlvii) oliguria, anuria, and uraemia; (xlviii) emergency operations upon the kidney; (xlix) the bladder; (l) the bladder (*continued*); (li) the prostate and seminal vesicles; (lii) the urethra; (liii) the penis; (liv) the testes and scrotum.

Hamilton Bailey's *Emergency surgery* is now in its 6th edition and can be said to be established as an English classic. Its standard of publication is very high and its illustrations are beautiful to a marked degree; but the issue of this edition in paper-covered parts—a method adopted to overcome difficulties and delays in binding—detracts very much from the value of the book as a whole, and from the reader's ease in handling it. There will be five parts in all.

The lay-out of the work is not substantially changed but the author's industry in directly approaching a wide circle of surgeons of experience in emergency work, and his generous acceptance of criticism—and even a daring search for it—have improved the descriptions of many of the techniques which were covered in previous editions.

The only criticism one might make is that prominence is given to too many little tricks which are neater in the diagram than in actual practice, and many of the diagrams suggest that the operations of emergency surgery are more simple than in fact they usually prove to be.

This book is a very valuable one for a resident surgical officer or house surgeon to have available. It would not be too much to say that its author established his reputation by its deserved popularity.

Ian Aird

CHILD HEALTH

Epidemics in Schools: an Analysis of the Data Collected During the Years 1935 to 1939

E. A. Cheeseman. London: His Majesty's Stationery Office, 1950. (Medical Research Council Special Report Series No. 271.) vii + 96 pages. 24 × 15 cm. 3s. [£0.15]

(i) Introduction; (ii) populations exposed to risk; (iii) main causes of sickness; (iv) influenza and nasopharyngeal infection; (v) infectious diseases; (vi) rheumatism; (vii) otitis media; (viii) sinusitis; (ix) pneumonia; (x) gastro-intestinal disorders; (xi) appendicitis; (xii) jaundice; (xiii) trauma; (xiv) tinea cruris; (xv) conjunctivitis; (xvi) tuberculosis; (xvii) deaths; (xviii) time lost from school; (xix) summary and conclusions. References.

This report of the Medical Research Council (by Dr Cheeseman of the Statistical Research Unit at the London School of Hygiene and Tropical Medicine) should be read in conjunction with the earlier report of the Medical Research Council published in 1938 (Special Report Series, No. 227). Dr Cheeseman analyzes the information obtained from 18 boarding-schools (13 boys' and 5 girls'). The analysis was limited to sickness occurring during school terms and involving absence of one or more days from school. The ground covered includes, *inter alia*, influenza and nasopharyngeal infection, infectious diseases, rheumatism, gastrointestinal disorders, jaundice and conjunctivitis.

As was to be anticipated, nasopharyngeal infection was found to be responsible for more sickness than any other individual cause, and was at a minimum usually in the summer terms, and very much more prevalent in girls' schools than in boys'. The investigation would suggest that in boys' schools measles is the most likely of the infectious diseases to be spread, and scarlet fever the least likely. On the other hand, in girls' schools measles did not appear to be more likely to spread than any other infectious disease. The explanation offered for this apparent sex differentiation is the greater care taken in girls' schools to prevent the spread of the infection by earlier isolation and removal of contacts.

Once again the apparent association between herpes zoster and chickenpox has been shown. The findings of the 1930–34 investigation (see Special Report Series, No. 227) have been strengthened, in so far as 80 per cent of the pupils in the boys' and girls' boarding-schools who were attacked by herpes zoster had previously suffered from an attack of chickenpox. It would seem reasonable to assume, therefore, that an attack of chickenpox does not necessarily confer immunity from herpes zoster. Only five cases of poliomyelitis were reported from the schools during the period under review; consequently no statistical deduction was attempted. It is of interest to note that a high degree of association was found between the incidence of acute and subacute rheumatism on the one hand, and scarlet fever on the other. As in the previous report, an attempt has been made to analyze the seasonal and sex incidence of appendicitis. As one might fairly anticipate, the figures appear confusing and one is left to assume that it would be unwise to accept either a seasonal or a sex priority. Of the 82 reported cases of jaundice, no less than 36 occurred as single cases. However, 20 cases occurred in one school in the summer term of 1936, and a further eight cases in the following term. On these figures Dr Cheeseman supports the findings of the previous report that "in certain environmental conditions it [jaundice] is mildly infectious".

It is not suggested that Dr Cheeseman has found any new solution

to the old epidemiological problems, but with the aid of some 60 tables he has produced a factual record. " In general these records provide a valuable picture of the incidence of different types of sickness, their seasonal and sex differences, and also allow study of points of particular interest with reference to specific infectious diseases."

H. L. Oldershaw

Infant Nutrition : its Physiological Basis

F. W. Clements. Bristol : John Wright & Sons Ltd., 1949. vi + 246 pages ; 14 figures. 22 × 14 cm. £1 1s. [£1.05]

(i) Some aspects of tissue metabolism ; (ii) foetal nutrition—general considerations ; (iii) foetal nutrition—carbohydrate, protein, fat and minerals ; (iv) foetal nutrition—vitamins ; (v) foetal nutrition : summary and clinical application ; (vi) the chemical and physical properties of human and cow's milk ; (vii) digestion in the young infant ; (viii) water metabolism ; (ix) energy requirements ; (x) requirements of nutrients ; (xi) application of the principles ; (xii) disturbances of metabolism of dietetic origin. Index.

This book is a careful compilation of knowledge gathered during the last twenty years, by workers all over the world, concerning the nutritional requirements for the proper development of the human young. Among the most interesting sections are those concerning the foetus, and the action of the placenta in its role as transmitter of nutrients. A structure such as the human placenta that brings together two circulations over an area of 10 to 13 square miles must command our respect, if only for its potentiality for either starving or surfeiting the foetus ; and we may all take a lesson from the placenta in the art of growing old gracefully in order to benefit our dependants. The time is ripe for a grand assault on the dimly-lit bastion of antenatal paediatrics, and Dr Clements' early chapters will fan the flame of enquiry into the many problems concerned with prenatal development.

The field of nutritional requirements during the first year or two after birth is somewhat easier for the investigator, and here the author has presented differing views with skilful impartiality, and more often than not has left the reader to judge for himself. Unfortunately it is difficult to gather what day-to-day experience Dr Clements has had in the care and supervision of either healthy or sick infants—for instance, it is hard to discern precisely how he would artificially feed a premature baby. Nevertheless, as Senior Medical Officer to the Commonwealth Department of Health in Australia and as Chief of the Nutrition Section of the World Health Organization, Dr Clements has had to face infant nutritional problems on the grand scale.

The author set himself the task of collecting present-day knowledge of the nutritional needs of infants ; in this he has eminently succeeded, and his book makes this knowledge available for us all. It will certainly be of interest to paediatricians, and ought to stimulate the obstetric world, but it does not set out to be a practical guide for the doctor or welfare nurse concerned with advising mothers about how to feed their infants.

Wilfrid Sheldon

Krämpfe im Kindesalter

Hans Zellweger. Basle : Benno Schwabe & Co., 1948. 195 pages ; 28 figures. 24 × 16 cm. 18 Sw. fr.

(i) Einleitung ; (ii) respiratorische Affektkrämpfe ; (iii) Fieber- oder Infektionskrämpfe ; (iv) Blitz-, Nick- und Salaamkrämpfe (Grusskrämpfe). Literaturverzeichnis.

This volume is a careful and detailed investigation of certain convulsive conditions of childhood, and, although not new, will probably remain the most up-to-date work on the subject for some years to come. It opens with a discussion of the mechanisms, such as muscular, spinal and cerebral, underlying convulsions. The theories advanced to explain cerebral convulsions are examined in detail. Cerebrovascular spasm, water retention, hypocalcaemia, pH changes, abnormal sympathetic-parasympathetic balance, electrical dysrhythmia, poisons and abnormalities of the blood-brain barrier are discussed, and examples given. An extensive list of disease states associated with fits is included, and a broad division into functional fits (*Gelegenheitskrämpfe*) and fits due to chronic cerebral disease is made. Hereditary and constitutional proneness to fits, the variability of the fit threshold at different times in the same individual, and the influence of external factors (avitaminosis, fevers, infections) are illustrated with clinical examples. The multiplicity of causative agents in many cases is stressed.

This general introduction precedes the main part of the monograph, which deals with breath-holding attacks, febrile convulsions and the salaam spasm group. The author has been able to draw on a large number of cases studied in considerable detail, but unfortunately no electroencephalographic studies were carried out. This very seriously detracts from the value of this otherwise admirable study.

Breath-holding attacks were found in children between the ages of nine months and four years, though a few occurred in children of up to eight years. The attacks took place only when a witness was present, and were clearly temper tantrums by which the child, usually an only one, blackmailed the parents. As would be expected, abnormal neurological findings were scarce ; weight, height, blood analysis and cerebrospinal fluid (C.S.F.) examinations were normal ; and a family history of neuroses or domestic upsets was frequent. The author claims, however, that these children all developed " degenerative stigmata " during the follow-up period, and that they all had a small sella turcica. The evidence for the stigmata is somewhat slender, as the author considers moist hands, dermatographia, acrocyanosis and other signs of " vegetative imbalance " as pathological. He considers that the question of differential diagnosis does not arise, that the prognosis is good, and that simple explanation and domestic adjustment will cure the condition.

Febrile convulsions make up most of the author's material. Of these convulsions 75 per cent occurred between the ages of six months and three years, usually on the first day of the precipitating disease, often when the temperature reached its peak, but occasionally before that. The actual height of the pyrexia was found not to influence the severity of the convulsion. Blood-sugar, chlorides, calcium and phosphorus estimations were normal, acetonaemia and acetonuria were frequent. There was an occasional C.S.F. pleocytosis, and 50 per cent had a raised C.S.F. protein. The precipitating illnesses were upper respiratory infections, measles, dysentery, exanthema subitum, in that order of frequency. Prematurity and low birth-weight seemed to play a role in the frequency with which fits occurred, and the author found a high incidence of migraine, psychopathology, meningitis, cerebrovascular accidents, diabetes and gastric ulcer in these children's relatives ! Once again the allergic and exudative diatheses, and the vegetative imbalance, so beloved of Continental authors, were found in these patients. Minor radiological abnormalities of the skull, and slight deviations from a too rigid norm of skull circumference, were also the rule. In view of the fact that about 25 per cent of these children developed epilepsy during the follow-up period, one wonders just how many had, in fact, organic cerebral disease, and not merely fever convulsions. The author favours the theory of cerebrovascular spasm as a cause, together with the inherent liability of children to fits, and an associated neurovegetative imbalance.

Lastly, 32 cases of " lightning-nodding-salaam " spasm are described. This syndrome is clearly separated from the benign spasmus nutans, which the author rightly considers a different disease. He found salaam spasm to start between the ages of six and 18 months, and to be followed by rapid deterioration of mental faculties, so that almost all his cases became idiots or imbeciles, with their range of activity limited to primitive nutritional and defensive mechanisms. No abnormality was found in the blood, the C.S.F., the air encephalogram, or in the history of the pregnancy. In the family history epilepsy, neurasthenia, migraine, alcoholism and mental deficiency were found in a percentage similar to that of epileptics. The differential diagnosis includes congenital syphilis, encephalitis and its sequelae, birth trauma and diffuse sclerosis, and occasionally the diagnosis of these salaam spasms presents difficulty. As no anatomical studies are available, the etiology is obscure, but the author is of the opinion that these spasms are not related to epilepsy. No treatment is of any avail.

The monograph ends with an extensive bibliography, almost exclusively of Continental sources.

B. Gans

MEDICAL SCIENCES & RESEARCH

Recent Advances in Chemotherapy. Volume I

G. M. Findlay. Third edition. London: J. & A. Churchill Ltd., 1950. ix + 625 pages. 21 × 14 cm. £1 16s. [£1.8]

(i) History of chemotherapy; (ii) chemotherapy of diseases due to insects; (iii) chemotherapy of helminthic infections; (iv) chemotherapy of amoebiasis; (v) chemotherapy of babesiasis and other protozoal infections; (vi) chemotherapy of leishmaniasis; (vii) chemotherapy of trypanosomiasis. Index to authors. Index to subjects.

Chemotherapy is here defined as " that branch of therapeutics which deals with the treatment of parasitic infections by drugs with the object either of eradicating the parasites from the body or of destroying them without damage to the tissues of their host ". It also includes drug treatment of neoplasms and prophylaxis by drugs, but not the use of aspirin to relieve headache, and the use of similar remedies.

Dr Findlay's two previous editions of *Recent advances in chemotherapy* (issued in 1930 and 1939 respectively) are too well known to require description. In the last ten years the subject has expanded so greatly that four volumes are now required to cover it. Volume I (here reviewed) covers diseases due to insects, worms and protozoa (other than malarial parasites); Volume II (published 1951) deals with malaria; Volume III will deal with syphilis, leprosy, rickettsiae, etc., and Volume IV with sulphonamides and antibiotics. When the 1st edition appeared, chemotherapy could deal only with protozoal and helminthic diseases, especially syphilis, trypanosomiasis, and malaria. When the 2nd edition came out in 1939 the sulphonamides had been described and many bacterial infections were at last brought under therapeutic control. During the last ten years, progress has been even more rapid, the principal advance being due to the antibiotics—penicillin, streptomycin, chloramphenicol and aureomycin; but great progress has also occurred in the treatment of malaria and of other protozoal and helminthic diseases. The larger viruses, such as lymphogranuloma and psittacosis, can now be attacked by drugs, but most of the other viruses and cancer remain outside the range of chemotherapy, while the response of tuberculosis is still very unsatisfactory.

The title, *Recent advances*, is a misnomer for the present work, since it is really a complete review of chemotherapy from its early beginnings up to the present times (i.e., to about 1948). As such it is the only one of its kind, and it will be invaluable in enabling the student of this subject to cover the ever widening field, contributions to which are now scattered through so many different kinds of journals. The book is written from the medical and biological aspect rather than from the chemical one. The various sections are grouped according to the pathogenic organisms involved and much attention is given to the clinical and toxic effects of the various compounds. Yet attention is also paid to the chemical aspect, and ample descriptions are given of other members of the various chemical series in addition to those which have finally been adopted for clinical use. Besides the diseases of man, accounts are also given of the chief diseases of animals in which chemotherapy has been effective.

The book is a compilation of the published literature on chemotherapy rather than a critical evaluation of conflicting data or rival claims. The data recorded by various workers are reproduced and summarized and the reader is left to form his own conclusions. The scope of this compilation is astonishingly wide, and notice is taken of many small but significant reports which are buried in papers on other topics and thus might have easily escaped notice. When the student has read the appropriate section he can be sure that mention has been made of practically all the important papers in this field, though it might often be advantageous for him to consult the originals of those which seem particularly pertinent to his purpose. As with all rapidly advancing subjects, it is difficult to keep a book on chemotherapy completely up to date. The present volume covers the ground completely up to 1948, and a few references are given to papers published in 1949. Extensive references are given at the end of each section. It would probably have been a little easier to consult these if they had been grouped at the end of the volume; but each arrangement has its advantages and disadvantages, and many readers may prefer the arrangement which has been adopted. In any case, reference to the publications of any worker is facilitated by a detailed index of authors.

As has been said above, this work is really a complete review of chemotherapy, the only one existing, and as such it will be invaluable to all in this field. Dr Findlay is to be congratulated on his courage in undertaking this ambitious task and on his success in accomplishing it. The appearance of the remaining volumes will be eagerly awaited.

F. Hawking

Handbook of Physiology and Biochemistry Originally " Kirkes' " and later " Halliburton's "

R. J. S. McDowall. Centenary (fortieth) edition. London: John Murray, 1950. x + 767 pages; 315 figures. 24 × 16 cm. £1 10s. [£1.5]

(i) Physiology; (ii) the structure and characteristics of living things and the general design of the body; (iii) excitability and stimulation; (iv) muscle; (v) the contraction of muscle; (vi) involuntary or unstriated muscle; (vii) the blood; (viii) the circulatory system; (ix) the circulation; (x) physiology of the heart; (xi) the circulation in the blood-vessels; (xii) the control of the circulation; (xiii) the blood depots; (xiv) the lymphatic system; (xv) respiration; (xvi) respiration (*continued*); (xvii) the relation of respiration to other processes in the body; (xviii) the chemical composition of the body; (xix) physical chemistry and its bearing on physiological problems; (xx) general metabolism and energy exchanges; (xxi) diet; (xxii) food; (xxiii) the structure of the alimentary canal in relation to its function; (xxiv) secretion; (xxv) saliva; (xxvi) digestion in the stomach; (xxvii) digestion in the intestines; (xxviii) some methods used in investigating digestive juices; (xxix) the absorption of food; (xxx) the mechanical processes of digestion; (xxxi) intermediate metabolism; (xxxii) the liver; (xxxiii) the urinary apparatus; (xxxiv) the urine; (xxxv) the urine (*continued*); (xxxvi) reproduction; (xxxvii) the growth and repair of the body; (xxxviii) the pituitary body; (xxxix) the constancy of the internal environment; (xl) the acid-base equilibrium of the body; (xli) the functions of the skin; (xlii) body temperature; (xliii) the nervous system; (xliv) physiology of nerve; (xlv) the central nervous system; (xlvi) the spinal cord and spinal nerve-roots; (xlvii) the reflex activities of the animal; (xlviii) structure of the cerebrum; (xlix) sensory nerve-endings; (l) sensation; (li) the sensory pathways; (lii) the physiology of conscious states; (liii) voluntary movement: hypothalamus and basal ganglia; (liv) the nutrition of the central nervous system; (lv) speech and voice; (lvi) taste and smell; (lvii) hearing; (lviii) the eye and vision; (lix) the autonomic nervous system; (lx) the ductless glands. Important physiological data. Bibliography. Index.

" Kirkes' Physiology " reflected the teaching at St Bartholomew's Hospital from 1848–96. The 7th edition (1869) was published by John Murray and the book has been the property of that famous firm ever since. Professor Halliburton's editorship began in 1896 and in 29 years 17 editions (totalling 116,000 copies) were published. The association with King's College, London, continued when Professor McDowall became responsible for the revision of the work. In the 35th edition (1937) " Biochemistry " appeared on the title-page for the first time. The present edition celebrates the passing of 100 years of usefulness and looks forward to continued success. The work is a fine example of publishing and printing and the price is remarkably low for a book of this kind at the present day. It is lavishly and discerningly illustrated and the new edition maintains the distinguished level in physiology of its predecessors.

The present reviewer has been asked to comment on developments in biochemistry in successive editions, presumably because it is in this field that the greatest changes have been necessary. It is a matter of great regret to him that it is impossible to greet the centenary edition without a certain disquietude. It is to be feared that no working biochemist accustomed to teaching medical students could agree that the book adequately reflects the mood, the content and the tools of contemporary biochemistry, or that it correctly estimates the amount of organic chemistry the medical student can and should learn. Physiology and biochemistry are now such large subjects that errors of fact, of emphasis and of tactics in presentation are inevitable unless the reviser's work is checked by specialists. This checking has not been done adequately in the biochemical sections.

Thus reference is made (p. 234) to " the cholesterol of the plants " and the " ergosterol of the skin " (also p. 295) and calciferol is said to be " even more active than vitamin D " (p. 295). The whole section on vitamins needs revision. Molecular formulae are given for some vitamins but the structural formula is shown for B_1 only. It is said that vitamin E has been found valuable in the treatment of habitual abortion. Folic acid, vitamin B_{12}, *p*-amino benzoic acid, co-enzyme I are not mentioned in the index and no reference to them has been found in the text. " Adenine triphosphate " is, however, given in the text (p. 122) and in the index.

Although much of the standard descriptive biochemistry is dealt with here as satisfactorily as in most books, the treatment of metabolic cycles is inadequate and, judged as presentation, is not

very consistent. Such matters as transamination, transmethylation, modes of action of vitamins, biochemical anatagonism and the use of radioactive and other stable isotopes are hardly mentioned. The biochemistry in fact shows a certain naïveté which does not correspond with the scientific maturity of the rest of the book, nor with the needs and capacities of the best medical students. The biochemical treatment also needs many more cross-references.

If the word biochemistry is to retain the right to a place in the title of this great work, the need for a biochemist to assist Professor McDowall in the preparation of the next edition is very evident. Some rather drastic revision is required if the student is to gain from the book a forward-looking attitude towards medical biochemistry. No comment such as this can diminish the general appreciation of Professor McDowall's work in revising successive editions of the book, but the pressure of advancing biochemistry on editors is relentless and a reviewer cannot but state the facts as he sees them.

R. A. Morton

The Biochemistry of the Nucleic Acids

J. N. Davidson. London: Methuen & Co. Ltd., 1950. ix + 163 pages; 4 plates; 15 figures. 17 × 11 cm. 7s. 6d. [£0.375]

(i) Introduction; (ii) the hydrolysis products of the nucleic acids; (iii) chromatography applied to the nucleic acids; (iv) the structure and properties of the polynucleotides and nucleoproteins; (v) nucleases and related enzymes; (vi) ultraviolet absorption by the nucleic acids; (vii) histochemical tests for nucleic acids; (viii) chemical methods for nucleic acid estimation; (ix) the nucleic acid content of tissues; (x) nucleic acids in the cell cytoplasm; (xi) the cell nucleus; (xii) the metabolism of the nucleic acids; (xiii) the biosynthesis of the nucleic acids; (xiv) the biological activity of the nucleic acids; (xv) the nucleic acids in bacteria and viruses. References. Index.

Methuen monographs are now so widely known that a warm welcome is likely to greet the first number of a new series on biochemical subjects. That the nucleic acids have been chosen as subject-matter for the pioneer volume of the series will also be approved, since the monographs of Jones and of Levene & Bass are long out of date and the essentials of this rapidly developing field lend themselves to presentation in the limited space of this "pocket" series.

The classical tetranucleotide structure of nucleic acids is discarded and replaced by a picture of mononucleotides (up to several thousand) linked by phospho-ester groups in chains of indefinite length and without regularity of arrangement along the chain. In this way the new fractional analytical figures for purine/pyrimidine molar ratio are explained and the substantial requirement of biologists in stereoisomeric forms can be met. Only the *x*-ray crystallographers appear to be dissatisfied with the new conception.

The initial chemical chapters form an enduring foundation for the book. The succeeding histochemical section is also well written but the significance of the work is more difficult to assess. It leads to chapters concerned with Claude's fractionation of cell cytoplasm and Mirsky's similar work on the nucleus. In both cases, the more critical reader—and especially the colloid chemist—will wonder how far the physical and chemical properties of the cell components so isolated are due to events which take place during the mechanical disruption of the cell. One may question the wisdom of building a massive biochemical superstructure on relatively crude methods of handling what is after all probably nature's supremely complex colloidal system.

The book concludes with chapters on metabolism, biosynthesis and biological activities of nucleic acids which are more satisfying and represent masterly summaries of recent work. From practical experience the author is well aware of pitfalls inherent in the newer techniques—for example, in the use of tracer phosphorus—and the reader has the benefit of his critical judgement in these matters. Indeed the book is outstanding for the excellent judgement shown in the selection of information. Only well-established facts are given and these are succinctly stated without the mass of conflicting information which all too frequently encumbers modern biochemical reviews. The student for an honours degree will find enough for his purposes here and the research worker in other branches of biochemistry will do well to learn from this book the lessons which the nucleic acids have to teach. It deserves to have a very wide circulation.

A. S. McFarlane

Genes, Plants and People: Essays on Genetics

C. D. Darlington & K. Mather. London: George Allen & Unwin Ltd., 1950. xxi + 187 pages; 13 figures; 1 plate. 22 × 14 cm. 16s. [£0.8]

(i) Introduction: the early hybridizers and the origin of genetics; (ii) polyploids and polyploidy; (iii) cytological theory in relation to heredity; (iv) the biology of crossing-over; (v) chromosome chemistry and gene action; (vi) race, class and mating in the evolution of man; (vii) heredity, development and infection; (viii) outbreeding and separation of the sexes; (ix) heterothally as an out-breeding mechanism in fungi; (x) genetics and the Russian controversy; (xi) polygenic balance in the canalization of development; (xii) genetical control of incompatibility in angiosperms and fungi; (xiii) the genetical approach to improvement in man; (xiv) genes; (xv) the significance of nuclear change in differentiation; (xvi) heredity versus disease; (xvii) the unity and power of biology. Appendix: the new Soviet genetics, 1947.

The title *Genes, plants and people* perhaps leads the reader to expect a work written in the mode of popular scientific journalism. It consists in fact of 17 reprinted articles, of which 12 first appeared in *Nature*, ranging in date from 1929 to 1948. Their subject is genetics and some extrapolations from genetics. The only portion of the book written jointly by the authors is the preface; this is not surprising for they seem to differ in their approach to the subject. Mather's contributions consist in the main of the presentation of facts and conclusions drawn from them, while Darlington's mainly consist in the presentation of the tentative speculations of others (or his own earlier speculations) which he uses as a basis for further speculations that merge imperceptibly into conclusions. The second method is certainly the more stimulating but the first is in the end more satisfying, and certainly less liable to lead the unsuspecting reader astray.

The opening sentences of the conclusion of the most recent of Darlington's reprinted articles from *Nature* may serve as an example of his approach.

> Proteins in the cytoplasm can now be put in a rough genetic classification. On the one hand there are some proteins, perhaps the bulk, put together by the nucleus with the help of desoxyribose nucleic acid. Perhaps, as Caspersson has suggested . . . the larger types of protein arise from the euchromatic genes, the smaller from the heterochromatic. And perhaps, as Pontecorvo has suggested . . . the heterochromatic genes, or polygenes of Mather, are characterized by the repetition of similar and, no doubt, simple elements. They would be more like plasmagenes.

The general student to whom the book "should serve to introduce the concepts and methods of genetics" (preface) may be unaware that little is known of the properties and composition of the cytoplasmic proteins of the animal and even less of those of the plant. Our unfortunate lack of knowledge means that this classification can be applied only to imaginary proteins. The student may also be unaware that we do not know how proteins are synthesized in the cell and that the work of Ris & Mirsky and of Commoner indicates that much of the evidence on which Caspersson based his views must be re-evaluated. Finally the very existence of plasmagenes is still an open question.

It is unfair to criticize views put forward several years ago, in the light of later evidence, but if these views are reprinted with no accompanying commentary indicating that they may have to be modified, they may serve as a confession of faith, but not as an introduction to the general student. There is no doubt that Darlington's ideas are both valuable and stimulating, but their validity cannot be judged now and perhaps not for many years to come.

M. V. Tracey

PATHOLOGY & BACTERIOLOGY

An Introduction to Pathology

G. Payling Wright. London: Longmans Green & Co., 1950. x + 569 pages; 235 figures. 23 × 16 cm. £1 10s. [£1.5]

(i) Introduction; (ii) aetiology: the causes of abnormalities and diseases; (iii) the inheritance of abnormalities; (iv) infection: the early phases; (v) infection: its establishment; (vi) infection: the dissemination of micro-organisms within the body; (vii) the inflammatory reaction; (viii) therapeutic modifications of the inflammatory reaction; (ix) the effects of injurious agents upon cells: degenerations and necrosis; (x) tissue reactions in virus infections; (xi) reparative processes in connective tissues; (xii) chronic inflammation and amyloidosis; (xiii) regeneration of parenchymatous cells; (xiv) general reactions to infection: fever, leucocytosis and immunity; (xv) thrombosis; (xvi) ischaemia, embolism and infarction; (xvii) haemorrhage and haemostasis; (xviii) oedema; (xix) hypertrophy and atrophy: morphological adaptations to functional requirements; (xx) neoplasia: introduction and nomenclature; (xxi) the modes of spread of malignant tumour cells and the formation of metastases; (xxii) the morphology and metabolism of tumour cells; (xxiii) the aetiology of tumours: hereditary factors; (xxiv) the aetiology of tumours: exogenous factors; (xxv) the aetiology of tumours: endogenous factors and general discussion; (xxvi) the 'precancerous state'; (xxvii) the pathology of some of the more common tumours. Index of names. Index of subjects.

This book, described as an "introduction to pathology", is planned to help the student to grasp the basic "mechanisms which underlie disease processes"; it is an "exposition of the principles of Pathology in terms of the more fundamental sciences of Biology and Physiology". For a quarter of a century there has been a very real need for such a book, and this need has become urgent during the last ten years when so much endeavour in pathology has been directed to the perfection of laboratory "tests" in the essentially practical problems of diagnosis and the control of treatment. As a result, the teaching of pathology has been more and more concerned with clinical diagnosis, and those who teach the subject have been increasingly concerned to find that the modern student is being starved of an adequate training in the principles of the science. The book is planned to meet this danger, and it is gratifying to find that it has been written by an author with so wide a knowledge of the scientific aspects of pathology, and so outstanding a talent for accurate generalization. One of its chief merits is its literary style. There must be very few medical books published in recent years whose subject-matter is presented in such lucid and distinguished English. It will certainly be read with ease and enjoyment.

The treatment of the subject is essentially functional and dynamic. Relevant discoveries in biology, physiology and immunology are skilfully blended with the static facts of morbid anatomy and histology. Pathogenesis, the march of events in the evolution of disease processes, is heavily stressed and no opportunity is lost in persuading the student that to understand disease in the living he must think of it in terms of morbid physiology. The references cover an exceptionally wide field and have been selected with great care, and the illustrations are of high quality. This work is without question an outstanding contribution to pathological literature, and the modern student is fortunate to have such a companion to accompany him throughout the whole of his clinical training.

Geoffrey Hadfield

NEUROLOGY & PSYCHIATRY

Physiology of the Nervous System

John Farquhar Fulton. Third edition. New York: Oxford University Press; London: Geoffrey Cumberlege, 1949. x + 667 pages; 140 figures. 22 × 15 cm. £3 15s. [£3.75]

(i) The receptors; (ii) dorsal spinal nerve roots and the dermatomes; (iii) the motor unit; (iv) synapses and elementary reflexes; (v) central inhibition; (vi) the spinal cord: flexion and reflex; (vii) the spinal cord: extension reflexes; (viii) the spinal cord: intersegmental reflexes. Spinal man; (ix) the medulla oblongata: decerebrate rigidity; (x) the medulla oblongata and midbrain: postural reflexes; (xi) the pons and midbrain: optic reflexes; (xii) autonomic nervous system; (xiii) the hypothalamus and the autonomic nervous system; (xiv) the thalamus; (xv) cerebral cortex: architecture, intracortical connections, motor projections; (xvi) cerebral cortex: the olfactory system; (xvii) cerebral cortex: the occipital lobes and visual system; (xviii) cerebral cortex: the temporal lobes; (xix) cerebral cortex; the parietal lobes and somatic sensation; (xx) cerebral cortex: the motor areas and pyramidal system; (xxi) cerebral cortex: extrapyramidal and intracortical projections; (xxii) cerebral cortex: the orbitofrontal and cingulate regions; (xxiii) cerebral cortex: autonomic representation in precentral motor cortex; (xxiv) the extrapyramidal motor system: basal ganglia and reticular formation; (xxv) the cerebellum; (xxvi) the nervous system as a whole: the conditioned reflex. Bibliography and author index. Subject index.

This book will be known by all neurologists; indeed, since it has become one of the standard reference books which medical students are advised to keep at their elbows, the great majority of younger doctors will also be familiar with it. Professor Fulton, therefore, has successfully catered for a real need by providing what is "essentially an exposition of the experimental physiology of the nervous system in which material has been assembled that will aid those whose ultimate objective is the study of Clinical Medicine."

The 1st edition appeared in 1938, the 2nd in 1943, and now the 3rd edition of 1949 brings the book up to date. It has been carefully revised and Professor Fulton shows a critical insight into recent developments by his impartial yet judicious selection of new material.

The book is divided into 26 chapters, beginning with a detailed account of the receptors and ending with a consideration of the nervous system as a whole. Each chapter is preceded by a brief but well-chosen historical introduction, and notice is taken of all relevant anatomical and neurohistological factors. The new material appearing in this edition is as follows: (i) the discovery of secondary sensory and motor areas in the cerebral cortex and the attempts that have been made to elucidate their significance; (ii) the disclosure by Magoun and Rhines of inhibitory and facilitatory areas in the reticular formation and the related observation that the suppressor areas of the cerebral cortex (McCulloch), as well as those of the anterior cerebellum (Nulsen), operate through the reticular formation; (iii) the emergence of the orbital surface of the frontal lobes, the anterior cingulate, and the tip of the temporal lobe as important autonomic centres of the forebrain; (iv) the disclosure that discrete functional localization exists in the anterior cerebellum; and finally (v) the discovery that changing the rate of stimulation of nearly any excitable focus in the central nervous system alters the character of the response, and that from many foci either excitation or inhibition can be obtained by altering the rate of stimulation, provided the individual current pulses are of optimal duration. In addition, the most recent information, acquired by leucotomy, on the subject of the functional localization in the frontal and temporal lobes of the human brain, has been summarized in the final chapter.

The author's enthusiasm and abounding energy are evident throughout the book, but the chapters are not too long or too detailed to overwhelm the average reader; the text is only 568 pages long. The extensive bibliography (75 pages) is an invaluable supplement, especially to those who want to go deeper into a particular subject.

Once again, Professor Fulton is to be congratulated on the way in which he has continued to understand and meet the requirements of his readers.

G. Weddell

Perspectives in Neuropsychiatry. Essays Presented to Professor Frederick Lucien Golla by Past Pupils and Associates

Edited by *Derek Richter.* London: H. K. Lewis & Co. Ltd., 1950. viii + 236 pages; 11 figures. 22 × 14 cm. 15s. [£0.75]

(i) The anatomical perspective in neuropsychiatry; (ii) anatomical lessons from prefrontal leucotomy; (iii) neural nets and the integration of behaviour; (iv) electroencephalography as an instrument of research in psychiatry; (v) features in the electro-physiology of mental mechanisms; (vi) the cerebral mechanisms of intelligent action; (vii) the biochemistry of cerebral function; (viii) perspectives in the endocrinology and pathophysiology of mental disturbances; (ix) the concept of the schema in neurology and psychiatry; (x) the relationship of mind and matter to personality; (xi) perspectives in psychiatric genetics; (xii) forensic psychiatry: retrospect and prospect; (xiii) aims and methods of treatment; (xiv) mental hospital problems. Index.

This book contains 14 essays presented to Professor Golla on his seventieth birthday by past pupils and professional colleagues. With the exception of a philosophical paper by Dr Russell Brain, and discussions of forensic problems by Sir Norwood East and of the problems of mental hospital care by Dr Gjessing, the papers are chiefly devoted to anatomical, physiological and chemical aspects of mental illness. In its emphasis on these aspects of neuropsychiatry the book faithfully reflects the orientation of the Bristol school to which we owe so many important contributions in this field. The essays are to a considerable extent speculative, reviewing the growing points of medical research rather than presenting factual surveys of territories already occupied. From the clinical point of view the papers of Dr Denis Hill on " Electroencephalography as an instrument in research in psychiatry " and of Dr Alfred Meyer on " Anatomical lessons from prefrontal leucotomy " are of immediate interest, but to any worker in this field every contribution is worthy of careful reading on its own merits.

The general emphasis of the book is towards a sometimes rather mechanistic empiricism, in striking contrast with similar productions from the other side of the Atlantic. It is interesting to speculate on the relative roles, in this orientation, of intellectual and economic factors—of the work of Professor Golla and the many British psychiatrists whose approach is essentially similar, and of the economic circumstances which, spreading psychiatric care thinly over the whole population of the welfare state, render a primarily psychopathological and psychotherapeutic approach to mental illness rarely practicable at the present time. More than a hint as to the role of the economic factor is offered by Dr Sargant in his excellent paper on " Aims and methods of treatment " in which the accent on physical methods of treatment, so characteristic of the rather similarly orientated Maudsley school, is clearly related historically to the practical difficulties presented by the psychiatric care of large numbers of patients after the evacuation of the British Army from Dunkirk.

This book is easy and stimulating reading, a worthy tribute to a great neuropsychiatric investigator and deserving of a place on the bookshelves of any physician working in the realms of nervous disease.

Henry Miller

The Psycho-Analytic Reader. An Anthology of Essential Papers with Critical Introductions

Edited by *Robert Fliess*. London : Hogarth Press & Institute of Psycho-Analysis, 1950. (The International Psycho-Analytical Library, No. 38.) xvii + 358 pages ; 1 table. 22 × 14 cm. 18s. [£0.9]

Part I. Clinical. (i) Neuroses ; (ii) psychoses ; (iii) characterology. Part II. Theory. (iv) Female and preoedipal sexuality. Part III. Miscellaneous. Part IV. Uncollected papers by Karl Abraham. Part V. References by Freud.

This is an anthology of psychoanalytical papers selected partly on the editor's estimate of their merits and partly because, for linguistic or other reasons, they have not so far been readily accessible to the English reader. The second of these conditions is a somewhat capricious reason for selection and does not as a rule sustain a uniform standard of scientific appraisal. A paper may not have been translated or reprinted because at the time it did not appear to be of sufficient merit. Despite the hazards of selection, however, it must be admitted that in the present instance the result is surprisingly good.

The best section of the book is that dealing with the infantile sexual development of the female, including papers by Helene Deutsch, Mack Brunswick and Lampl-de Groot. This is a subject which many psychoanalytical writers have attempted to deal with, not without damage to their own emotions and to their reputation for perspicacity ; and a good deal of psychoanalytical blood has been drawn during controversies on the various issues involved ; nevertheless the papers here selected give a balanced account of the complications and difficulties with which the problem is beset.

Of considerable historic interest are the papers of Tausk on the " Influencing machine " in schizophrenia, and Mack Brunswick's account of the termination of the analysis of Freud's famous " Wolf-Man " ; these, incidentally, are contributions of some practical importance to the psychiatrist. Criminologists will be interested in the late Karl Abraham's description of a psychopathic impostor who apparently recovered after marrying a woman who counteracted his previously persistent mother-negative. A paper by Fenichel on transvestism is also of clinical interest ; and some short passages taken from the works of a number of psychoanalysts are also of historical value as having been specifically referred to by Freud in his own writings.

Less satisfactory is the choice of Wilhelm Reich's papers on characterology which throw very little light on this intricate subject and are in any case out of date. Readers should not regard these articles as representative of present-day psychoanalytical characterology, which in fact has concentrated more and more on the influence of important unconscious identifications on the structure of the ego. In any case the influence on character of different phases and modifications of instinct, although certainly profound, is manifested less in the direct imprints of experience than in the structural defences or reaction formations developed by the ego.

With this main exception the judgement of the editor is pretty sound and his glosses add to the ease and instruction of the reader. At the same time it must be admitted that the book does not entirely fulfil the expectations expressed by the publisher. Calling for a good deal of previous analytical orientation, it cannot be regarded as particularly suitable for the general student. On the other hand it should be found on the bookshelves of more advanced students, all psychoanalysts, many psychiatrists and a sprinkling of normal psychologists.

Edward Glover

Collected Papers on Psycho-Analysis

Ella Freeman Sharpe. Edited by *Marjorie Brierley*. London : Hogarth Press Ltd. & Institute of Psycho-Analysis, 1950. (The International Psycho-Analytical Library, No. 36.) viii + 280 pages. 22 × 14 cm. £1 1s. [£1.05]

(i) Contribution to symposium on child analysis (1927) ; (ii) the technique of psycho-analysis. Seven lectures (1930) ; (iii) a note on " the magic of names " (1946) ; (iv) the psycho-analyst (1947) ; (v) certain aspects of sublimation and delusion (1930) ; (vi) similar and divergent unconscious determinants underlying the sublimations of pure art and pure science (1935) ; (vii) psycho-physical problems revealed in language : an examination of metaphor (1940) ; (viii) cautionary tales (1943) ; (ix) Francis Thompson : a psycho-analytical study (1925) ; (x) the impatience of Hamlet (1929) ; (xi) from *King Lear* to *The Tempest* (1946) ; (xii) an unfinished paper on Hamlet : introduction and extracts. List of publications. Index.

Ella Freeman Sharpe (1875–1947) was one of the small group of non-medical psychoanalysts whose work played a large part in the early history of psychoanalysis in London. Between the years 1904–16 she was mistress of English and co-head with a man of a pupil teachers' training centre for boys and girls between the ages of 15 and 18. Her knowledge of many adolescents and her specialist's knowledge of literature, poetry and drama allowed her to bring a background to psychoanalysis which the study of medicine would not have given her. In 1917, at the age of 42, she gave up her teaching position and began to study psychoanalysis.

Her psychoanalytic work had two main aspects : her original work on the psychoanalytic interpretation of art and the artist, and her work as a teacher in training psychoanalysts, which included an appreciation of the relation of psychoanalysis to education in general.

In 1937 *Dream analysis*, a practical handbook for psychoanalysts, was published as No. 29 in a series of which the volume under review is No. 36. The present volume includes seven lectures on technique (pages 9–98) which are of both practical and suggestive value to psychoanalysts and to all psychotherapists.

Miss Sharpe's knowledge of literature, especially of Shakespeare, enabled her to make the contributions outlined in the three papers (pages 125–155) on the relationship between belief and delusion on the one hand, and the sublimations of artistic scientific work on the other. The three papers on Shakespeare (203–244) give a fair picture of what she would have produced had the energy, vitality and original ideas which continued to dominate her work, even during the last years of life, lasted until the plan to write a book outlining Shakespeare's infantile development, as it can be inferred from some aspects of his plots which are repeated over and over again, had been fulfilled.

This volume includes all her published work except *Dream analysis* and a few papers published elsewhere on the relationship of psychoanalysis to education. It and *Dream analysis* are two of the most important psychoanalytic works produced as the result of clinical work in England. Both will be essential to students for many years to come.

W. Clifford M. Scott

Delinquency and Human Nature

D. H. Stott. Dunfermline: Carnegie United Kingdom Trust, 1950. viii + 460 pages. 25 × 16 cm. 5s. [£0.25] [Not available through trade channels]

(i) Introduction; (ii) avoidance (general); (iii) parental ill-health; (iv) parental quarrels; (v) desertion threats and inferiority; (vi) emotional estrangement from the parents (divided parent-relationships); (vii) emotional estrangement from parents following evacuation; (viii) feared desertion of parent; (ix) emotional difficulties following loss of parent; (x) boys unwanted or abandoned during childhood (withdrawal-reaction); (xi) boys unwanted or discriminated against during childhood (demonstrative plus withdrawal reactions); (xii) unsatisfactory parents—complete family unit (demonstrative reaction); (xiii) unsatisfactory parents—separated or re-married (demonstrative and other reactions); (xiv) unsatisfactory parents (neurotic and hysterical variations and some unclassified cases); (xv) conclusions and reflections. Appendices: I. Theoretical notes; II. Method and future research; III. Explanations and notes on the statistical summary. Index. Statistical summary.

In 1945 it was suggested to the Carnegie trustees by the headmaster of an approved school[1] that it might be valuable to carry out an intensive psychological study of a group of delinquent boys during their period of residence. Accordingly, the trustees generously arranged for Mr Stott to undertake such an inquiry, and have now issued his detailed report. Mr Stott's plan was to take 100 youths aged 15 to 18 in order of entry to the school; actually, by some small oversight, the total number is 102. Each was studied by means of interviews, unobtrusive observation, and reports from the author's colleagues on the staff and elsewhere. The results are presented in the shape of detailed case-histories; and a table showing an "analysis of motives", and a statistical summary, are given at the end of the book.

Mr Stott believes that the facts ascertained point to five main motives for juvenile crime, but all, he thinks, can really be reduced to one: "delinquent breakdown is an escape from an emotional situation which, for the particular individual with the various conditionings of his background, becomes temporarily at least unbearable". In the vast majority of cases the precipitating situation arises within the lad's home, and centres round his relationships with his parents. Mr Stott's conclusion thus broadly agrees with that reached in an earlier study of young delinquents in London (see Cyril Burt, *The young delinquent*, University Press, London, 1927): next to temperamental conditions in the delinquent himself, an unfavourable emotional attitude on the part of the relatives was then found to be by far the commonest factor. Mr Stott differs only in the fact that he tends to speak as though home conditions formed practically the sole important factor.

In many ways the most suggestive portion of this volume is contained in the long appendix on methodology. In the Introduction the author explains that the first large-scale investigation of the problem in Great Britain—that carried out by the Psychologist to the London County Council—introduced two new features: first, the combination of the "case-history method" with statistical analysis, and second, the parallel study of a carefully paired control-group side by side with the main group of delinquents: in addition, in that study, the information was collected, not just as it arrived, but primarily in accordance with a prearranged schedule of physical, mental, and environmental factors, based on earlier psychological analyses. Later investigators have usually followed the same approach, at least so far as the conditions of their work permitted.

Mr Stott brings forward plausible arguments for departing from what he describes as the orthodox procedure. Nevertheless, the final outcome is that his conclusions appear less convincing. Thus his descriptions of his cases are couched largely in an improvised or semi-popular vocabulary, where the terms used are often vague, ambiguous, and somewhat ill-defined; and the lack of system deprives us of any guarantee that the whole personality was covered in every case. As the group studied is far smaller than those used in earlier investigations, the need for a statistical evaluation is, if anything, more urgent than before: it is quite possible that peculiarities which are treated as fully significant may be due simply to the fluctuations of random sampling. Finally, since practically all the youths studied had been removed to an approved school, largely because their home conditions were so unsatisfactory, it was inevitable that he should find that, in his group, such conditions were closely associated with delinquent outbreaks. To give his argument full cogency, we obviously want, first, a parallel study of non-delinquents of the same social class to see how frequent unsatisfactory home conditions may be in a non-delinquent group, and, secondly, another parallel study of delinquents who have not been removed from home to see whether other causes besides home conditions may also play an effective part. It is to be hoped that such enquiries will be carried out in the near future.

Cyril Burt

[1] "Approved" schools are those which are approved by the Home Secretary for the purpose of educating juveniles who are delinquent or who are brought before a court and deemed to be "in need of care or protection."—Ed.

The Diagnosis of Hysteria

D. W. Abse. Bristol: John Wright & Sons Ltd., 1950. xii + 112 pages; 6 figures. 19 × 13 cm. 8s. 6d. [£0.425]

(i) Introduction; (ii) aetiology and psychopathology of hysteria; (iii) clinical manifestations of hysteria in Indian and in British soldiers; (iv) diagnosis; (v) summary and conclusions. Bibliography. Index.

Although the author's orientation is Freudian, this modest book is practical rather than profound. Historical theories of hysteria are briefly and competently presented, and excellent case-histories succinctly outlined. The chief clinical interest of the work lies in the author's experience with Indian military patients, and its main interest from the theoretical point of view is his claim that a psychoanalytic interpretation of hysterical symptoms is valid for patients drawn from a culture so different from that of Western Europe. One of the criticisms which Freudians find especially difficult to refute is that their theories not only bear the stamp of the place and period of their origin, but that their basic concepts are in fact inapplicable to civilizations differently organized. As far as the Indians are concerned—even soldiers whose contact with European ideas is presumably superficial—Dr Abse obviously feels otherwise, and he produces clinical evidence tending in this direction. The problem is of major importance and deserves further study.

The book is commendably inexpensive and should prove of value to those studying for psychiatric qualifications anywhere, and particularly in India.

Henry Miller

The Sexual Perversions and Abnormalities: a Study in the Psychology of Paraphilia

Clifford Allen. Second edition. London: Geoffrey Cumberlege, 1949. x + 346 pages. 22 × 14 cm. £1 5s. [£1.25]

(i) Instinct and its relation to sexual abnormalities; (ii) the instinctual development of the sub-human primate; (iii) the instinctual development in man; (iv) the nature and causation of the sexual perversions or paraphilias; (v) the sexual malversions; (vi) representative cases of sexual perversion; (vii) representative cases of sexual aversion, hypoversion, hyperversion, and malversion; (viii) the prevention, treatment, and prognosis of the sexual perversions and anomalies; (ix) medico-legal. Index.

Dr Allen has produced a 2nd edition of this well-known book, which undoubtedly fulfils a need, as there is no similar book published in Great Britain. This edition does not differ greatly from the 1st, but the author does make use of new work, such as that of Professor Kinsey.

Much of the book describes various sexual perversions, and gives essentially psychopathological explanations of their origin. This tends, of course, to considerable overlapping between different chapters, as the psychopathology of certain perversions does not always differ very considerably from that of others. There is a general lack of appreciation of the fact that sexual perverts tend to be totally abnormal individuals. Dr Allan admits that most of the psychopathology expressed is essentially Freudian, but when he finds a Freudian explanation unsatisfactory he expresses either personal views or the views of other authorities. A pure Freudian would, of course, disagree with this method, as he would not accept the rejection of even part of the general Freudian theory. Insufficient consideration of psychopathic behaviour in general is given. There is little doubt that many sexual perverts are really psychopathic personalities, and that many of both groups are constitutionally determined.

Dr Allen admits that he is optimistic on the whole with regard to treatment; it seems likely that many people would regard him as over-optimistic. It is extremely difficult to generalize about the effect of treatment on sexual perverts—possibly many patients seen by Dr Allen are more intelligent and co-operative than those usually seen in everyday practice. To regard a homosexual psychopath of low intelligence, with no wish to get better, as a hopeless problem from a psychotherapeutic view is not necessarily being pessimistic, but probably realistic. One would, of course, nevertheless agree with Dr Allen that many of the punitive measures adopted by

society against these individuals are quite ineffective and that society has not yet found the right method of dealing with them. On occasions, as suggested by Dr Allen, psychotherapy is effective. His book is an extremely valuable contribution to the subject and should be read by all those who have to deal with such problems; it will, however, be inadequate to those without a wide knowledge of psychiatry. This is a pity, as it is quite likely to be read by members of the legal profession and others.

Robert Orton

Electroencephalography. A Symposium on its Various Aspects

W. A. Cobb, G. D. Greville, M. E. Heppenstall, D. Hill, W. Grey Walter & D. Whitteridge. Edited by *Denis Hill & Geoffrey Parr.* London: Macdonald, 1950. vii + 438 pages; illustrations. 25 × 20 cm. £3 18s. [£3.9]

(i) Introduction; (ii) recording equipment and technique; (iii) technique—interpretation; (iv) physiology; (v) biochemistry; (vi) pharmacology; (vii) normal rhythms—their development, distribution and significance; (viii) epilepsy; (ix) intracranial tumours; (x) cerebral trauma; (xi) psychiatry. Appendixes. Indexes.

This important book has been written by a team of workers in electroencephalography, whose combined interests cover the whole of its field. This is no small statement, because a full understanding of electroencephalography demands knowledge of electronics and electrical engineering as well as of electrophysiology and clinical methods. A number of descriptive books and atlases have appeared before, but this is the first time that an attempt has been made to include in a single cover the essentials of this very diffuse subject, and Dr Hill and Mr Parr are to be congratulated on the way they have integrated the work of their team of authors.

After a knowledge of electronic physics and its application to circuits, a subject here dealt with by Dr Grey Walter and Mr Parr, who are specialists in this, it is next important to understand the physics of wave form, upon which interpretation of records is based. Dr Grey Walter handles this lucidly, calling upon his own work on frequency analysis and that of Dr G. D. Dawson on wave synthesis. In an admirable chapter, Professor Whitteridge discusses the physiology of neuronal activity, and then biochemistry and pharmacology are described by Dr Heppenstall and Dr Greville.

After these two hundred pages upon introductory subjects Dr Grey Walter deals with the electroencephalogram in normal subjects and in epileptics; and the clinical section is completed by Dr Cobb dealing with organic disorders and Dr Hill with psychiatric problems.

There is a number of appendixes dealing with even more technical matters and a most detailed bibliography. The text is profusely illustrated with circuit diagrams, graphs, and specimen records.

Every department of neurology and electroencephalography will have to possess this large and necessarily expensive textbook, and in it all serious students, whether technical, scientific or clinical, will find a short cut to knowledge. The work is intended only for those actually working in the subject, but, by dipping into sections, others will find well-integrated knowledge. This is valuable, for there are no other authoritative sources yet available outside specialized journals.

Denis Williams

Electrophysiological Technique

C. J. Dickinson. London: Electronic Engineering, 1950. vii + 141 pages; 60 figures; 1 plate. 22 × 14 cm. 12s. 6d. [£0.625]

(i) Introduction; (ii) valve standardization; (iii) power supplies; (iv) methods of display and recording of electrical changes; (v) trigger circuits; (vi) time bases; (vii) biological amplifiers; (viii) D.C. amplifiers; (ix) electrodes; (x) L.F. oscillators; (xi) stimulators; (xii) time marking and measurement; (xiii) the production of mechanical movement; (xiv) display and recording of mechanical movement; (xv) pressure and volume registration; (xvi) measurement and control of heat; (xvii) light measurement. Table of references. Valve base diagrams. Index.

The author's intention in this book is to provide information of the maximum practical value about the various types of electronic apparatus in use in the physiological laboratory. To this end, there is no theoretical treatment, but well-known, reliable examples of each of the types of circuits discussed are presented. Clear circuit diagrams showing all the component values are given and there is a short list of the more recent publications on the subject.

In addition are chapters on the application and method of use of various types of apparatus (see chapter titles). Lastly there are a useful collection of data for preferred valves and an appendix of valve base diagrams.

The research worker or technician with some previous knowledge of the technical terms of electronics could build and operate the circuits described from the data presented. Some of the detailed descriptions would be made easier to follow by graphical illustration, and the inclusion of lists of common faults and their usual causes in the case of the more important circuits would have been useful to the beginner. This book deserves the place on the bench for which it was intended and it may serve as a useful introduction to workers in fields other than physiology to some of the interesting work electronic circuits can do in the laboratory. But as with all purely practical manuals the user must proceed warily.

D. O'Connor

TROPICAL MEDICINE

Child Health in Warm Climates

W. K. Blackie. London: Longmans Green & Co., 1950. x + 182 pages. 19 × 13 cm. 7s. 6d. [£0.375]

(i) Sleep; (ii) diet in childhood; (iii) diet in childhood (*continued*); (iv) protection against the tropical sun; (v) protection against disease; (vi) protection against disease (*continued*); (vii) common episodes in childhood. Index.

The seven chapters of this book, packed with information, provide a useful guide for doctors, child-welfare workers, teachers, nurses and intelligent parents, on the elements of child care in tropical areas. Sleep and diet come first and the author has many useful things to say. Then comes a controversial chapter on the effects of the sun, which sets out the dangers and the means to avoid them, with a slight bias towards the "pith helmet" school of thought. The remaining sections deal with protection against disease and with certain diseases common in childhood.

The author writes well and it is regretted that he did not expand the book to include other matters. A surprising omission is any account of dysentery. Some discussion on the psychological problems of early life would have been valuable in relation to special aspects of tropical upbringing such as the influence of the native "nanny", and whether or not children should be sent away from their parents to the United Kingdom (or elsewhere) for school and at what age. It would be valuable to see the arguments set out now that many adolescents born in East Africa, for example, have, owing to the war, never been "home" at all. Sir Godfrey Huggins contributes a foreword less as Prime Minister of Southern Rhodesia than as a some-time resident at The Hospital for Sick Children, Great Ormond Street, London!

A. Moncrieff

Schistosomiasis in South Central Africa: a Clinico-Pathological Study

Michael Gelfand. Cape Town & Johannesburg: published for The Post-Graduate Press by Juta & Co. Ltd., 1950. 239 pages; 23 figures. 25 × 16 cm. £1 5s. [£1.25]

(i) Introduction; (ii) the incidence of bilharziasis; (iii) urinary bilharziasis; (iv) intestinal bilharziasis; (v) the appendix and bilharziasis; (vi) pulmonary bilharziasis; (vii) bilharzial disease and the liver; (viii) the pancreas and bilharziasis; (ix) the gall bladder and bilharziasis; (x) schistosomal involvement of the brain and spinal cord; (xi) schistosomiasis of the female genitalia; (xii) diagnostic aids; (xiii) a brief résumé. Bibliography.

Those who are acquainted with Gelfand's excellent work that has been performed in recent years will not be disappointed with

this fine monograph on a subject which is becoming of increasing importance to all those Central African countries which cluster round the great lakes; especially is this the case in the Rhodesias, where schistosomiasis presents a very real problem.

In this work the author has paid special attention to the c inico-pathological aspects. He probably is the first person with the essential training who has been able to use his unrivalled opportunities to study this disease at first hand, so that he has been able to correlate the different aspects in a manner hitherto unachieved. Especially important is the conclusion that schistosomiasis (of the intestinal type) does not predispose to carcinoma, whilst equally convincing evidence is adduced that hepatic schistosomiasis does not lead to cirrhosis.

Regarding diagnosis, special attention has been paid to the intradermal test, which has been in use now for over 30 years. One would have thought that by now an authoritative statement as to its efficacy would be forthcoming and it is felt that if it were entirely reliable it undoubtedly would have been greeted with universal recognition. The cercarial antigen test is perhaps better and is of some value in this part of Africa as a pointer, or diagnostic aid, to the disease.

Eosinophilia is to be expected in the early stages of this disease and is usually high; later it becomes less marked or may even be absent. Unfortunately, however, a normal eosinophil count does not necessarily indicate that the patient is not affected with schistosomiasis and the formol-gel test is of only limited value.

This monograph is furnished with an extensive bibliography which occupies some 11 pages, and it is to be highly recommended to everyone who is engaged in the study of tropical disease.

Philip Manson-Bahr

SOCIAL MEDICINE

The Food of the People: Being the History of Industrial Feeding

Noel Curtis-Bennett. London: Faber & Faber Ltd., 1949. 320 pages; 30 illustrations. 22 × 14 cm. 16s. [£0.8]

(i) The Middle Ages: country; (ii) the Middle Ages: towns; (iii) the rise of capitalistic organizations; (iv) the seventeenth and eighteenth centuries; (v) the Industrial Revolution; (vi) Robert Owen and the nineteenth century; (vii) the new spirit in industry; (viii) war and the industrial canteen; (ix) inter-war and second war; (x) the future of industrial canteens. Bibliography. Index.

The food of the people has little to do with industrial canteens and, having chosen his title, Sir Noel Curtis-Bennett places Mr Ronald Ogden and himself under the unfortunate need of proving that it has. Facilities for feeding at the place of work were provided first as a convenience and then, in the First and Second World Wars, as a necessity for production. The travelling of long distances to work and mass transfers of workers to new and isolated factories are recent social phenomena, and canteens a convenient means of filling the consequent need.

In feudal days the common man either ate what was left over from the baronial table—and there was plenty—or eked out a miserable existence on bad meat and fish, rye bread and perhaps milk and cheese. How precarious feeding was is vividly described in the opening and best chapters of this book. Failure of the harvest meant starvation, in a sense that a nation which today spends £410 million a year on food subsidies cannot understand. Very few vegetables were grown, and it was not until the 16th century that the many varieties we now know began to be cultivated in England. By and large, during the 17th and 18th centuries, feeding was good even in workhouses (which really were "working" houses), and in children's orphanages and prisons. Vast quantities of food, including every variety of first-class protein, were consumed by the upper classes regularly and by the working classes at special celebrations. In 1765, England became a wheat-importing instead of a wheat-exporting country, and so began our present food trouble.

In a fiercely individualistic society the rift between employer and employed, both supposedly free men, was the cause of all our subsequent ills. Bad feeding is but one, and the present book gives a good and accurate account of food eaten, or not eaten, by industrial workers. The "hungry forties" are aptly so named. As in other reforms, individual employers led the way in improving the feeding of industrial workers. At first, some employers confined themselves to arrangements for heating prepared meals. The very interesting comment is made that, apart from special groups, the habit of bringing a meal from home to be heated at work, which declined steadily as canteen facilities developed, died out during the Second World War.

As an instrument of government policy, industrial canteens are useful; extra food can be given to those who are thought, on the basis of official or political guesses, to need it. A discussion of the implications of this policy might have been included, especially by one who so clearly believes in private enterprise. Is there any inherent reason why a miner (the food arrangements at pits are described excellently) should receive priority over a non-pregnant, non-lactating, non-diabetic, non-tuberculous housewife, other than on a basis of economic production? No, industrial canteens are a production necessity. In spite of confusion between welfare and production, and valiant efforts in the last chapter to prove the contrary, canteens remain a convenient means of feeding groups of people. Even though a canteen should be a friendly place and not just "an eating shop", to relate canteens to the "many disasters" affecting marriage seems very far-fetched. More than a canteen is needed to make a community centre; those with experience of war-time hostels could hardly visualize them as more than a necessity and even the best-run hostels had many disadvantages. The basis of the food of the people is in the home of the people, that is, in the family unit. Mothers rather than skilled canteen managers and cooks determine how well the nation is fed.

The early chapters benefit by references to social history: the later suffer from considering industrial canteens separately from the nutritional and social policy forced on the country by war. Also, these later chapters appear to have been produced by the scissors-and-paste method; long and appropriate but, in total, boring extracts are given from official and unofficial reports. Though the account of the development of canteens is accurate and valuable, it lacks discussion of the wider social circumstances. The book is well produced and the illustrations are good. The text references are not given in a clear form of abbreviation, which is a pity, as many newcomers to the subject should be stimulated to further reading.

T. A. Lloyd Davies

HISTORY & BIBLIOGRAPHY

Essays in the History of Medicine

George Gask. London: Butterworth & Co. Ltd., 1950. viii + 209 pages; illustrations. 25 × 17 cm. £1 10s. [£1.5]

(i) Early medical schools; (ii) Vicary's predecessors; (iii) the medical staff of King Edward the Third; (iv) the medical services of Henry the Fifth's campaign of the Somme in 1415; (v) a contribution to the history of the care of the sick and wounded during Marlborough's march to the Danube in 1704, and at the Battle of Blenheim; (vi) John Hunter in the campaign in Portugal, 1762–3; (vii) Lettsomian lectures; (viii) changing surgery. Bibliography of the writings of George Ernest Gask. Index of subjects. Index of personal names.

Some five hundred friends, students and colleagues have arranged for the publication of this collection of essays as a tribute to the author, Professor George Gask, Emeritus Professor of Surgery, London University, on the occasion of his seventy-fifth birthday.

The first of these essays is concerned with the myth that Hippocrates drew his knowledge and inspiration from the temple medicine of Cos. Here Professor Gask does more than contrast temple magic and the Hippocratic mode of thought and practice: he builds up a careful picture of the earlier contributions to natural science and shows that the roots of Hippocratic medicine lay deep in the work of the early Greek philosophers and were a long way removed from the irrational cult of Aesculapius. This study is followed by short accounts of the schools at Cos, at Cnidos, and at Alexandria. Here, and elsewhere, a good book is marred a little by the kind of repetitions which should always be looked for—and rarely are—when essays written at different times are collated for publication.

It is good to read again the 1930 Vicary Lecture with its extracts from the Pipe Rolls and the Patent and Close Rolls listing the surgeons who served the kings of England from the time of Edward the Confessor up to the appointment of Thomas Vicary himself. There are separate studies of the medical staff of King Edward III and of King Henry V, both fully documented. Especially well done is the account of Marlborough's march to the Danube and the Battle of Blenheim. What little information there is about the care of the sick and wounded has been carefully collected and set in perspective against the tactics and strategy of the campaign. In the same way the letters of John Hunter and the account of his work as an Army surgeon in Portugal in 1762–63 are set in the larger political frame. The campaign itself was unimportant but the documents relating to it, all preserved by the Earl of Loudoun, include a number prepared by Hunter himself, and others which show well the medical and hospital arrangements.

In describing methods of treating wounds of the chest from the year 1300 up to the present century Professor Gask emphasizes the decrease in mortality from wounds after the substitution of high-velocity pointed bullets for lead balls. His account of the treatment of similar wounds in the 1914–19 war was written in 1921 and is a model which might well be studied by the chest surgeons of a later generation. In the same series of Lettsomian Lectures Professor Gask also reviewed the surgery of diseases of the thorax. The last essay, entitled "Changing surgery", a presidential address delivered to the Medical Society of London in 1935, has its own special interest. It mentions the difficulties of financing medical and hospital care for those patients outside the National Health Insurance scheme who were not rich enough to pay for all the treatment they might need. Professor Gask wondered then "if the answer will prove to be compulsory universal insurance?" His question has since been answered.

This is a well-produced volume, which bears engaging witness to Professor Gask's interest in the history of military medicine. It is not a book to read at a sitting and some of the going is heavy. Although it has the defects of every collection of essays, each essay contains some items of interest and there are three studies which are outstandingly good. [Professor Gask died on 16 January 1951, after this review was written.—ED.]

I. Harvey Flack

The Portraiture of William Harvey

Geoffrey Keynes. London: The Royal College of Surgeons of England, 1949. 32 pages; frontispiece; 32 plates. 25 × 19 cm. £1 5s. [£1.25]

The iconography of William Harvey has long interested Mr Geoffrey Keynes, who made it the subject of his Thomas Vicary Lecture, 1948. This lecture is here published, making available the most important study of the subject since Sir D'Arcy Power's *Portraits of Dr William Harvey*, 1913.

Mr Keynes begins by outlining the history of portraiture in Britain, a subject which has apparently never been fully pursued, and from his careful study of the portraits he is able to give a clear picture of Harvey's appearance during life. He points out that although there are in this country and America some 34 portraits that have been supposed to represent Harvey, our knowledge of how he really looked can be derived from only a few genuine sources. After a careful study of the material available, he places these in order of importance. First comes the state portrait now in the library of the Royal College of Physicians of London, ascribed to Cornelius Janssen; second the portrait in the Hunterian Collection, University of Glasgow, attributed to William van Bemmel; and third the marble bust by Edward Marshall, in Hempstead Church, Essex, near Harvey's sarcophagus. These three, and these only, represent Harvey as he certainly was. One, the Hunterian portrait, is not mentioned by D'Arcy Power.

Mr Keynes describes how, during the preparation of the Vicary Lecture, he inspected at Rolls Park, near Chigwell, Essex, a hitherto neglected portrait of Harvey. Rolls Park was at one time the property of Harvey's brother Eliab. On one wall of the portrait room at Rolls Park, now unoccupied and suffering from war damage and post-war decay, were portraits of Thomas Harvey and his seven sons, of whom William was the eldest. Two, those of Eliab and Matthew, had recently been stolen, but that of William was intact; having been fixed in the wall with a plaster surround for nearly two hundred years, it had suffered much from dirt and neglect. It has now been removed to the National Portrait Gallery for safe keeping. It shows Harvey at the age of about 45, with hair still dark and heavy moustache. It would have been painted several years before the appearance of the *De motu cordis* and thirty years earlier than any other known portrait of Harvey. The author is to be congratulated on saving this important picture. It was apparently first mentioned by D'Arcy Power (*Ann. med. Hist.* 1929, n.s. **1**, 241), who reproduced a photograph of all the portraits on the then intact wall.

He describes, too, how Sir Richard Quain visited the Harvey vault at Hempstead in 1868 and "reported that the lead of Harvey's casket was much decayed with a wide crack in it and he was horrified when a large frog jumped out. He paid another visit in 1878 and reported further decay, but that the crack had been narrowed by the collapse of the leaden walls. This at least excluded the larger reptiles from Harvey's embrace, but another inspection in 1882, after the sudden collapse of the church tower, showed that the shell was full of water. It was then that the Royal College of Physicians took steps to see that Harvey's remains were more reverently disposed, out of the reach of frog and flood".

The book includes a catalogue giving full descriptions of seven portraits and the bust at Hempstead, as well as the portraits derived from them. There are also particulars of 12 portraits believed to be of Harvey but which in fact represent other persons. Finally there are excellent reproductions of all the pictures discussed and four photographs of the bust at Hempstead.

Among the immense literature on William Harvey Mr Keynes' scholarly study deserves a high place.

L. T. Morton

A Year with Osler, 1896–1897: Notes Taken at his Clinics in The Johns Hopkins Hospital

Joseph H. Pratt. Baltimore: The Johns Hopkins Press, 1949. xxi + 209 pages; 6 plates. 24 × 16 cm. £1 12s. [£1.6]

(i) Clinical notes; (ii) summary of typhoid fever cases; (iii) analysis of pneumonia cases. Appendix. Index of names. Index of subjects.

During the years 1896 and 1897, Dr Pratt took notes in Osler's clinics in the Johns Hopkins Hospital, and he has now made them available for the profession in the form of case histories; these form a valuable contribution to Oslerian literature. Hero-worshippers of Osler, and they are legion, owe a deep debt of gratitude to Dr Pratt, who in an admirable introduction describes the appearance and character of Osler, and recounts some typical anecdotes.

With this book older practitioners will find themselves once again, in spirit, with Osler at the bedside. Modern students will

appreciate how remarkably accurate diagnoses could be half a century ago with little or no help from laboratory investigations, *x*-ray photographs or other ancillary aids. The clinician's stock-in-trade consisted mainly of a carefully taken history, acute observation, and a leisurely physical examination, combined with a background of anatomy, physiology and pathology. Many of the diseases described in full will seem strange to the undergraduate of today. Syphilis in its crudest forms, with the presenting signs of gummata, rupia, aneurysm, etc., fills several sections of the book.

> Syphilis is the only disease you have to know. In order to understand the complications of syphilis you have to know surgery, dermatology, ophthalmology, otology, neurology, and internal medicine. In knowing syphilis well you bring in all the rest incidentally.

To this aphorism the reviewer feels Osler might have added tuberculosis, in the various ramifications of which he was always much interested. Another disease, chlorosis, described several times, is no longer seen; chronic parenchymatous nephritis and rheumatic fever are much less common now than then, at least in Great Britain. Students of that epoch must have had extensive knowledge of the complications of typhoid fever and pneumonia, as well as being thoroughly acquainted with malaria and acute pneumonic phthisis. On the other hand, in 1897 Osler mentions at one of his clinics, "Cancer of the lung is very rare. We have had no case in the hospital". There has been not only a change in the type of disease admitted to hospital, but a marked alteration for the better in social habits. Frequently we come across the statement that the patient was a hard drinker. In the report of one case of a man aged 61 years we read: "He says he is not exactly temperate, but has not been a heavy drinker. He drinks half a pint of whiskey a day"!

While demonstrating cases, Osler was in the habit, as those of us who knew him are well aware, of indicating where references could be found, often in very out-of-the-way journals. At the same time he would give a thumb-nail sketch of the clinician who first described a particular disease or physical sign, thus helping to impress on the student's memory the condition under review. In much the same way, and for the same purpose, he would mention the names of well-known people who had suffered from the complaint he was demonstrating. He would, for example, tell the class about Arnold of Rugby who died in his first attack of angina, while emphasizing in contrast that John Hunter expired in a fit of anger in his twenty-third attack. Osler was very careful to give priority to the practitioner who first described a disease. In the case of exophthalmic goitre for instance, he put the name of Parry before that of Graves or Basedow.

It is generally known that in Osler's textbook only a few lines were devoted to treatment at the end of his description of a particular disease. This, in fact, used to be a common complaint from the student population. In this record of Osler's hospital practice, quite a fair amount of space is devoted to the therapeutic aspect, even if nothing more than "salts and six weeks" in the case of catarrhal jaundice, or a mixture for chlorosis, consisting of the three essentials, "colour, taste and harmlessness".

The volume is well indexed and there are several photographs of Osler in characteristic attitudes. Both the established practitioner and the newly-qualified man or woman will add greatly to their knowledge and wisdom by a perusal of this excellent book.

William Stobie

The Middlesex Hospital, 1745–1948

Hilary St. George Saunders. London: Max Parrish, 1949. 100 pages; 4 plates; 26 illustrations. 23 × 16 cm. 8s. 6d. [£0.425]

(i) 1745–1800—for the sick and the lame of Soho; (ii) 1800–1850—the company of serious, thoughtful men; (iii) 1850–1900—the "respectable trained women"; (iv) 1900–1945—the great new hospital; (v) war is no stranger; (vi) something more than efficiency. Appendixes.

Although the Middlesex Hospital was founded little more than 200 years ago, a short time compared with some other famous London hospitals, it has in that period been particularly fruitful in producing great men and fortunate in those who have served it. Lacking the long history associated with St. Bartholomew's or St. Thomas's hospitals, yet it has by its record of service to the sick and research on their behalf attracted numerous great benefactors at a period when large donations were essential to provide the means for research and treatment.

Founded in 1735, it first occupied its present site ten years later. It thus came into being during the lifetime of Mead, Cheselden, Pott, the Hunters, and others who exerted so much influence on the development of medicine and surgery in Britain during the 18th century. By providing a maternity ward in 1747 the Middlesex became the first lying-in hospital in England. Among the physicians of the early days was Henry Vaughan, who later changed his name to Halford, became a baronet, President of the Royal College of Physicians for 24 years, and physician to four British sovereigns. Charles Bell came to the Middlesex as a poor young man and ended with a knighthood, having in the meantime aided in the founding of the Medical School (1836) and made important discoveries in anatomy and physiology—although, as Waller showed in 1912, he was not above plagiarism when claiming precedence over Magendie in the discovery of the dual function of nerve roots.

A glance at the appended lists of the staff will remind the reader of many other famous names in medicine and surgery. Perhaps the greatest in recent times was Sir John Bland-Sutton, who joined the Medical School in 1878 and earned the distinction of being its most brilliant student. His great reputation as a surgical teacher and his superb operative skill led him to the summit of his profession. His fame brought wealth, which he lavished on the School. When he died in 1936 he had become the most honoured surgeon the Hospital had known.

The book includes a full account of the work of the nursing staff, the development of research, and the work of the Hospital during wartime. The story is brought up to the present time and is strengthened by some fine illustrations. The author has skilfully avoided the mistakes so often associated with medical history told by a layman. He has made the best of the wealth of material available and has produced a book worthy of its great subject.

L. T. M.

Stedman's Medical Dictionary

Edited by *Norman Burke Taylor* in collaboration with *Allen Ellsworth Taylor*. Seventeenth revised edition. London: Baillière, Tindall & Cox, 1950. xliv + 1361 pages; 22 plates; illustrations. 24 × 16 cm. £3 5s. [£3.25]

In preparing this edition of "Stedman" the editors have revised the old definitions and added a considerable amount of new material. Trade names have, as far as possible, been deleted; a useful addition is the inclusion of short biographical notes of some of the important personalities in medicine. The book is rich in eponyms; we are glad that "Stedman" omits portraits, which, in the postage-stamp size compelled by dictionaries, are a useless waste of space. The main body of the book is preceded by a section on medical etymology which stresses the advantages of sufficient knowledge of Greek and Latin for the understanding of the formidable vocabulary that the medical student must acquire, and which includes a valuable explanation of word formation and a list of Greek and Latin root words used in medical terminology.

"Stedman" is one of the three pre-eminent medical dictionaries in the English (or rather American) language. Each has its comparative advantages and disadvantages; each has its champions and its critics, each its faults and misprints (although the latter are surprisingly few in so formidable a work). It would be invidious to make comparisons between "Dorland", "Gould", and "Stedman". All three are essential in a large library, and for the time being "Stedman" is the most up to date. The careful preparation of the present edition reflects great credit on the editors, and the book can be confidently recommended to those who need an authoritative medical dictionary of the first class. Its small type is beautifully machined and well leaded, which makes for comfortable reading.

L. T. M.

Maladies et Syndromes Rares ou Peu Connus: Description Clinique Répertoire des Signes et Liste des Noms Propres

A. Aimes. Second edition. Paris: Masson & Cie, 1950. viii + 334 pages; 31 figures. 23 × 17 cm. 920 fr.

(i) Exposé succinct des syndromes ou maladies rares ou peu connues; (ii) répertoire des signes principaux et liste des maladies et syndromes à noms propres.

The medical profession has its fair share of persons imbued with the collecting spirit; one common manifestation of this urge is the collection of rarities in diseases or syndromes. At first sight, this

fascinating book by a French bibliographer might seem designed for the searcher for the odd and unusual in medicine, but further study shows that Aimes has taken in a much wider field than might be expected. Thus he includes references to erythroblastosis, Gaucher's disease, the anomalies due to maternal rubella, the Cushing syndrome, and Ewing's tumour, to name a few of the better-known entries. The book is in fact a synopsis of the clinical and pathological features of the less common diseases, of great value for reference. It is not a source book. The aim is in each case, after a succinct but adequate note of the features of the condition, to provide a few modern (very often French) references for further reading. The French penchant for eponyms is well displayed; for example, cryptococcosis masquerades under the name of "Busse-Buscke" disease.

The work is up to date, references to publications in 1949 being included. It is unfortunate that in a bibliography of this nature so many minor blemishes should have crept in. Foreign names receive little mercy; Batty Shaw appears as Schaw, Volhard as Volard, Werlhof as Werlhoff, Wagener as Magener, *Clostridium* as *Claustridium* and so on. However, we must put up with these for the sake of the great mass of useful material collected.

S. S. B. Gilder

PARTICULARS OF BOOKS REVIEWED ELSEWHERE IN THIS NUMBER

The numerals in square brackets are the PAGE *numbers of the articles in which these books are reviewed*

[213] A History of English Public Health, 1834-1939

W. M. Frazer. London: Baillière, Tindall & Cox, 1950. xiii + 498 pages; 16 plates. 24 × 16 cm. £1 15s. [£1.75]

(i) Early experiments in sanitary legislation and organisation, 1848–71; (ii) the rise and development of environmental hygiene, 1871–1900; (iii) the personal health and social services—period of preparation, 1900–7; (iv) the personal health and social services—period of development, 1907–29; (v) modern public health and social medicine, 1929–39. Epilogue: a comprehensive health and social security service. Index.

[214] Ecology of Health: The New York Academy of Medicine Institute on Public Health, 1947

Edited by *E. H. L. Corwin.* New York: The Commonwealth Fund; London: Geoffrey Cumberlege, 1949. xii + 196 pages. 21 × 14 cm. £1

(i) Genetics and the public health; (ii) maternal health and nutrition: a problem in preventive medicine; (iii) animal and insect reservoirs of disease; (iv) climate, geography, and disease; (v) realities in preventive psychiatry; (vi) trends in state and local health service; (vii) the Hospital Survey and Construction Act and a nation-wide health program; (viii) the preparation of professional workers in the field of public health; (ix) education of the layman in health responsibilities. Index.

[214] Social Medicine, its Derivations and Objectives: The New York Academy of Medicine Institute on Social Medicine, 1947

Edited by *Iago Galdston.* New York: The Commonwealth Fund; London: Geoffrey Cumberledge, 1949. xvi + 294 pages. 21 × 14 cm. £1 2s. [£1.1]

(i) Changing concepts of the relation of medicine to society; (ii) social medicine: its differentiation from and relation to clinical and preventive medicine; (iii) epidemiology in social medicine; (iv) the place of nutrition in social medicine; (v) social psychiatry and social medicine; (vi) social applications of psychiatry; (vii) social medicine: the appeal of the common man.

[214] New Discoveries in Medicine: Their Effect on the Public Health

Paul R. Hawley. New York: Columbia University Press; London: Geoffrey Cumberlege, 1950. x + 134 pages; 15 illustrations. 21 × 14 cm. 16s. [£0.8]

(i) Our fabulous blood. Part I. Early discoveries. Part II. Development of transfusion as a therapeutic technique. Part III. The Rh factor; (ii) modern surgery of the heart and lungs; (iii) modern prevention and treatment of mental disease; (iv) the socio-economic aspects of medical care. Part I. Economic history of medical care. Part II. The prepayment principle.

[214] The Health of the People

S. Leff. London: Victor Gollancz Ltd., 1950. 288 pages. 20 × 13 cm. 12s. 6d. [£0.625]

Part One. Historical survey. (i) An introductory survey; (ii) the birth of the health services: sixteenth century-1834; (iii) the birth of the health services (continued): 1834–48; (iv) the growth and development of the health services: 1848–75; (v) living conditions: 1875–1919; (vi) medical conditions, 1877–1919; (vii) social and political background: 1875–1919; (viii) the health services in transition: 1919–48. Part Two. The present health services. (ix) The maternity services; (x) care of the child; (xi) the general practitioner service; (xii) the hospital services; (xiii) rehabilitation; (xiv) the industrial medical services; (xv) the administration of the health services; (xvi) conclusion.

[214] Medicine and Mankind

Arnold Sorsby. Second edition. London: Staples Press Ltd., 1950. 232 pages; 36 figures; 2 plates. 21 × 14 cm. 12s. 6d. [£0.625]

(i) Health and disease; (ii) health; (iii) disease: the ill-formed body; (iv) disease: the ill-balanced body; (v) disease: the abused body; (vi) disease: the assaulted body; (vii) treatment: individual measures; (viii) treatment: collective measures; (ix) social achievements and social frustrations; (x) on the horizon of time. Glossary. Index.

[214] Recent Advances in Social Medicine

Alan Carruth Stevenson. With a chapter by *Eric A. Cheeseman.* London: J. & A. Churchill Ltd., 1950. vi + 241 pages; 15 illustrations. 21 × 14 cm. 18s. [£0.9]

(i) Measurement of growth in children; (ii) infant mortality (1); (iii) infant mortality (2); (iv) the health of children in communal day nurseries; (v) the unmarried mother and her child; (vi) problem families; (vii) school medical inspection; (viii) some applications of statistical methods; (ix) notes on three subjects of interest: psychosomatic illness and social medicine; the adolescent in industry; "PULHEEMS." Index.

[217] Manson's Tropical Diseases. A Manual of the Diseases of Warm Climates

Edited by *Philip H. Manson-Bahr.* Thirteenth edition. London: Cassell & Co. Ltd., 1950. xiv + 1136 pages; 26 plates; 412 figures; 8 maps; 29 charts. 22 × 14 cm. £2 5s. [£2.25]

(i) Fevers; (ii) vitamin deficiency diseases (avitaminoses); (iii) abdominal diseases; (iv) infective granulomatous diseases; (v) diseases of the central nervous system; (vi) tropical venereal diseases; (vii) tropical skin diseases; (viii) local diseases; (ix) animal parasites and associated diseases; (x) diseases due to poisons, including snake-bite, and infection with dipterous flies and leeches; (xi) special subjects. Appendix. Section A: medical zoology; section B: clinical pathology. Index.

[219] British Code of Standards in Relation to the Advertising of Medicines and Treatments

Published with the approval and support of the Newspaper Proprietors Association, Newspaper Society, Periodical Proprietors Association, Proprietary Association of Great Britain, Advertising Association, Incorporated Society of British Advertisers & Institute of Incorporated Practitioners in Advertising. Second edition. 1950. 5 pages; indexes. 25 × 20 cm.

[221] General Notes on the Preparation of Scientific Papers

London: published for the Royal Society by Cambridge University Press, 1950. 26 pages; 3 figures. 22 × 14 cm. 2s. 6d. [£0.125]

Shorter Notices

Handbook of Bacteriology for Students and Practitioners of Medicine

Joseph W. Bigger. Sixth edition. London: Baillière, Tindall & Cox, 1949. xv + 547 pages; 109 figures. 21 × 14 cm. £1

The latest edition of this book, written primarily for medical students by an experienced teacher of bacteriology, will maintain the high reputation which it has enjoyed for many years. The extension of knowledge in the field of bacteriology since the 5th edition appeared ten years ago has necessitated a thorough revision, and additional material has increased the size of the book by 80 pages. A new chapter deals with the antibiotics and the section on viruses and the rickettsiae has been increased to 40 pages. The formulae for stains and culture media have now been transferred to a separate chapter at the end. As in previous editions, concise accounts of pathogenic protozoa and pathogenic fungi are included. In this edition the nomenclature of Bergey's *Manual of determinative bacteriology* has been accepted for many, if not all, genera and species of bacteria but the author, with praiseworthy caution, has been conservative in the matter of virus terminology. The illustrations, many of them new, are good and a few well-chosen electron micrographs have been added. The subject is treated along orthodox lines with the necessary emphasis on clinical application. The writing is clear and concise and if the need to cover such a wide field in limited space has resulted in some dogmatism in presentation, the book will on that account be no less acceptable to the medical student. His needs are admirably met by this compact little volume.

A. W. Downie

Asthma

Clement Francis. London: William Heinemann Medical Books Ltd., 1950. 36 pages; illustrations. 19 × 13 cm. 5s. [£0.25]

This book has been written by one who is fully versed in the study and treatment of allergy, being both Surgeon to the Metropolitan Ear, Nose and Throat Hospital, London, and in charge of its allergy clinic. Many different aspects of asthma, in particular the treatment of instability of the vasomotor system, are dealt with.

Dr Francis follows the technique used by his father, Dr Alexander Francis, and cauterizes the nasal septum of the patient. This technique, which has proved satisfactory in many thousands of cases, is fully described. That this cauterization has an immediate effect is witnessed by a change in the systolic blood-pressure and by a vasomotor effect on the warmth of the hands and feet. Advice is given on operative procedures for tonsils, sinuses and various nasal defects in the asthmatic, and a chapter is devoted to the giving of anaesthetics to this class of patient. The prevalence of nasal polypi in aspirin-sensitive cases is noted, together with the precautions necessary to avoid making the patient's asthma worse, instead of better, by too hasty removal of the polypi.

Much valuable advice is contained in this small book; it deserves the attention of all rhinologists and allergists.

Frank Coke

Industrial Health: an Introduction for Students

R. Passmore & Catherine N. Swanston. Edinburgh: E. & S. Livingstone Ltd., 1950. vii + 110 pages; 11 figures. 18 × 12 cm. 4s. 6d. [£0.225]

The subject of occupational health covers a vast field, and textbooks dealing with various aspects of it have been written. At the same time it is widely recognized that here the gap between knowledge and practice is all too large. This is partly because those concerned with supervision in industry are ignorant of many of the simple facts of industrial hygiene. In the past it has not been possible to present them with a suitable account of the subject. This little book admirably meets the need; it contains a concise and clearly written account of the principles of occupational health. The writers have drawn on their practical experience in presenting their material, which will be of value to doctors and nurses, managers, foremen, trades unionists and personnel officers.

The distribution in industries of the working population of the country is described, and accepted methods of assessing the health of working groups are given. The special problems associated with the young and the old are stated. Following this, an account is given of the physical environment, its measurement, and its effects on health. Emphasis is rightly given to the importance of psychological factors in environment; these greatly affect working efficiency, and possibly the total health of the individual. Short accounts are given of industrial accidents and occupational diseases, and so far as they go they are reasonably accurate. The need to condense has in certain cases led to an over-simplification. This fault is unavoidable in so small a book which deals with so vast a subject, and is far outweighed by its wide appeal. It is hoped that many readers will be stimulated to seek fuller information elsewhere.

The general practitioner is repeatedly being asked to undertake medical supervision of working groups—for this work he needs both re-orientation and facts, and this book provides them in a simple and attractive form.

R. E. Lane

Industrial Nutrition

Magnus Pyke. London: Macdonald & Evans, 1950. vii + 205 pages. 19 × 13 cm. 10s. [£0.5]

The factory canteen has become a commonplace of British industrial life, but, as the author points out, "there does not at the present time appear to be in existence any reasoned discussion" of the industrial worker's "special nutritional needs". The present work is an attempt to supply this deficiency in a readable way, not only for students of nutrition but for all who are interested in industrial welfare.

Some chapters, such as "Feeding the night shift", reflect the special purpose of the book, but others are of a more general character. "The significance of fat", for example, deals with sources of fat, fat requirements, and sugar compared with fat as a source of calories. "Accessory food factors" tells the story of the vitamins and has small sections on salt and iron. The whole book is sprinkled with impeccable references and many tables.

The psychological problem mentioned on p. 199 still exists. A famous obstetrician said fifteen years ago that people do not want vitamins, they need food; this is a view-point which the author echoes with: "People do not ingest calories and nutrients; they eat meals".

F.T.

Brompton Hospital Reports: a Collection of Papers recently Published from the Hospital. Volume XVIII, 1949

Research Department of the Hospital. London: Research Department of Brompton Hospital, [1950.] vii + 221 pages; illustrations. 22 × 14 cm. 12s. 6d. [£0.625]

The Brompton Hospital for Consumption and Diseases of the Chest collects in this well-produced volume papers published in 1949 by members of its Research Department, together with one paper first appearing in full, and statistics of types of cases treated. Author and subject indexes of both this volume and the preceding 17 are appended.

F. H. Young, in the newly-published contribution, emphasizes the efficiency of a good artificial pneumothorax, but shows that in some cases there is still often doubt of its value. J. Crofton analyzes a series of 54 cases of tuberculous cavities in the apex of the lower lobe, with D. A. Mitchison reports on 13 cases of bilateral pulmonary tuberculosis treated with streptomycin, and with J. R. Bignall describes 49 cases treated with antihistamine drugs for nausea and vomiting due to streptomycin. Other papers discuss the surgery of pulmonary stenosis, subphrenic abscess, and various aspects of chest disease.

A List of British Scientific Publications Reporting Original Work or Critical Reviews

Royal Society Information Services Committee. London: published for the Royal Society by the Cambridge University Press, 1950. 95 pages. 22 × 14 cm. 2s. 6d. [£0.125]

This little book is one of several valuable publications which have resulted from the Royal Society Scientific Information Conference, 1948.

Each entry includes the full title, the date of origin, a brief description of the content and of any indexes, frequency of issue, current volume number, approximate size of issue, size of page, whether summaries of papers are included, price per part and per annum, whether advertisements are accepted, where and how directions to authors can be obtained, and the name and address of the editor and the responsible publishing organization. Entries are arranged alphabetically under the names of the societies or publishing organizations. There is also an index to the journals and a general subject index.

The book is a model of preparation and printing, and should prove extremely useful. It is, however, surprising to note the omission of the *British Medical Journal*, which among medical journals enjoys the second largest circulation in the world, and of the *British Medical Bulletin*, which in its short life has done so much to sustain the prestige of British medicine all over the world.

L.T.M.

Analgesia for Normal Childbirth

E. H. Seward. Oxford: Blackwell Scientific Publications, 1950. vii + 19 pages; 4 figures. 22 × 14 cm. 2s. [£0.1]

This publication from the Nuffield Department of Anaesthetics, Oxford, compresses into 19 pages information which will be of great value to midwives and busy general practitioners. It is written by a man with experience in both anaesthetics and obstetrics—a rare combination. It discusses briefly the mechanism of pain production throughout labour and deals with those simple methods of pain relief which midwives are being trained to use.

The diagrammatic illustrations of the original Minnitt apparatus serve no useful purpose; the book would be better without them.

This booklet would be a useful "accessory" to every gas and air apparatus.

H. W. C. Griffiths

New Editions

A Pocket Obstetrics

Arthur C. H. Bell. Second edition. London: J. & A. Churchill, 1950. viii + 156 pages; 14 illustrations. 19 × 13 cm. 7s. 6d. [£0.375]

This book retains the scope and size of the 1st edition. As the author wrote in his preface to that edition, his aim is still "to present the fundamental lines of approach to the practice of Obstetrics both normal and abnormal".

The 1st edition was reviewed in *British Medical Bulletin*, 1947, Vol. 4, p. 433.

The Radiology of Bones and Joints

James F. Brailsford. Fourth edition. London: J. & A. Churchill Ltd., 1948. xiv + 760 pages; 615 illustrations. 25 × 19 cm. £3 3s. [£3.15]

The scope and purpose of this publication remain much the same as in the previous editions—to indicate the significance of radiographical findings and, also, to present recent advances recognized by *x*-ray departments; the latter aim has necessitated certain revisions and additions to the text; more than 200 radiographs have been added to the illustrations.

The 3rd edition was reviewed in *British Medical Bulletin*, 1944, Vol. 2, p. 89.

Practical Anatomy

W. E. Le Gros Clark. Second edition. London: Edward Arnold & Co., 1949. xvi + 493 pages; 268 figures. 22 × 14 cm. £1 10s. [£1.5]

The author says in the preface to this edition that it "is intended to be primarily a guide to the practical work undertaken by the student in the dissecting room". The text in the 2nd edition has been revised and rewritten and the illustrations have been much improved. New illustrations have been included and many of the original ones have been revised, and made more clear by the use of colour.

The Care of Children from One to Five

John Gibbens. Fourth edition. London: J. & A. Churchill, 1950. viii + 204 pages; 7 plates; 3 text-figures. 19 × 12 cm. 5s. [£0.25]

A new chapter, "Feeding errors and difficulties", appears in this edition and that on common diseases of childhood has been expanded. The author's aim, as in previous editions, has been to make this an easily understood guide for all those who have to deal with small children.

The 3rd edition was reviewed in Shorter Notices in *British Medical Bulletin*, 1947, Vol. 5, p. 279.

A Text-Book of Psychiatry for Students and Practitioners

David Henderson & R. D. Gillespie. Seventh edition. London: Geoffrey Cumberlege, 1950. xii + 740 pages. 22 × 14 cm. £1 12s. 6d. [£1.625]

The 7th edition of this work is the first to be published since the death of R. D. Gillespie. The whole text has been revised and the chapter on psychopathic states has been largely rewritten. Amongst the new material is a description of Eire's Mental Treatment Act, 1945, which abolished the necessity for the judicial authority in cases where certification is necessary.

The 6th edition was reviewed in *British Medical Bulletin*, 1944, Vol. 2, p. 256.

Short Manual of Regional Anatomy: Written for the Medical Student as an Aid to a Rapid Revision of the Whole Subject

J. A. Keen. Second edition. London: Longmans Green & Co., 1949. vii + 164 pages; 75 figures. 22 × 14 cm. 10s. 6d. [£0.525]

The author's aim in this book is to reduce the effort of memory demanded of the student by the study of anatomy. He attaches great importance to the simple diagrammatic figures with which the book is illustrated, which take the place of many pages of description. Paragraphs on surface markings of each of the anatomical regions have been added in this 2nd edition, but the text has been reduced by the omission of descriptions of the function and microscopic structure of organs.

The Essentials of Materia Medica, Pharmacology and Therapeutics

R. H. Micks. Fifth edition. London: J. & A. Churchill, 1950. x + 438 pages. 21 × 14 cm. £1 1s. [£1.05]

Many new drugs are described in this edition, among them being the amidone series of analgesics, B_{12}, cortisone, and dimercaptopropanol. The chapters on antibiotics, anti-malarial drugs, and anthelmintics have all been rewritten.

The 4th edition was reviewed in Shorter Notices in *British Medical Bulletin*, 1948, Vol. 5, p. 415.

Eye Surgery

H. B. Stallard. Second edition. Bristol: John Wright & Sons Ltd., 1950. xiii + 667 pages; 550 illustrations. 23 × 15 cm. £2 12s. 6d. [£2.625]

The text of this 2nd edition has been revised and additions have been made, e.g., in the description of recent practices in the technique of penetrating and lamellar corneal grafting, of certain glaucoma operations and of cataract extractions. Also 212 new illustrations have been added.

The 1st edition was reviewed in Shorter Notices in *British Medical Bulletin*, 1947, Vol. 5, p. 281.

An Introduction to Clinical Perimetry

H. M. Traquair. Sixth edition. London: Henry Kimpton, 1949. xv + 332 pages; 257 illustrations; 5 coloured plates. 27 × 19 cm. £2 2s. [£2.1]

In the extract from the preface to the 1st edition, which is printed in this 6th edition of the work, the author states that his aim is to introduce to the reader the essential principles of perimetry, considered in their clinical aspect. In the 6th edition the text has been revised and amplified and two coloured plates and two new illustrations have been added.

The 5th edition was reviewed in Shorter Notices in *British Medical Bulletin*, 1948, Vol. 5, p. 418.

Disorders of the Blood. Diagnosis: Pathology: Treatment: Technique

Lionel E. H. Whitby & C. J. C. Britton. Sixth edition. London: J. & A. Churchill, 1950. xii + 759 pages; 12 coloured plates; 94 text-figures. 25 × 16 cm. £2 2s. [£2.1]

There have been many advances and many changes of opinion in haematology, particularly in such subjects as coagulation, corpuscular antigens, and specific therapy, since the last edition of this book appeared in 1946. In the 6th edition the text has been increased by 85 pages, and 4 plates and 23 illustrations have been added. Also, many chapters have been rewritten.

The 5th edition was reviewed in *British Medical Bulletin*, 1946, Vol. 4, p. 296.

Elementary Anatomy and Physiology

James Whillis. Third edition. London: J. & A. Churchill, 1949. viii + 296 pages; 108 illustrations. 24 × 17 cm. 16s. [£0.8]

The purpose of the 1st edition of this book, which appeared in 1938, was to make the study of the body more interesting and profitable to the student during his first year of medicine. The 3rd edition remains substantially unchanged, but the chapter on muscles has been expanded to include sections on skeletal dynamics and the mode of action of muscles in everyday activities.

The 2nd edition was reviewed in *British Medical Bulletin*, 1945, Vol. 3, p. 62.

Books Received

July 1950—November 1950

Reviews of many of these books appear in this number of the Bulletin or will appear in future numbers

Aimes, A. *Maladies et syndromes rares ou peu connus : description clinique—répertoire des signes et liste des noms propres.* 1950. Masson (Paris), 920 fr.

Asociación Mexicana de Ginecología y Obstetricia y Sociedades Filiales. *Primer Congreso Mexicano de Ginecología y Obstetricia . . . Ponencias oficiales.* (Mayo 22–28 de 1949.) 1950. Asociación Mexicana de Ginecología y Obstetricia (Mexico, D.F.)

Bach, F., editor. *Recent advances in physical medicine.* 1950. Churchill (London), £1 7s. 6d. [£1.375]

Barbier, J. & Piquet, G. *Manuel de sédimentation sanguine.* 3rd ed. 1950. Masson (Paris), 380 fr.

Bodson, S. P., Downie, A. W., MacCallum, F. O. & Stuart-Harris, C. H. *Virus and rickettsial diseases.* 1950. Arnold (London), £1 4s. [£1.2]

Bell, G. H., Davidson, J. N. & Scarborough, H. *Textbook of physiology and biochemistry.* 1950. Livingstone (Edinburgh), £2 5s. [£2.25]

Biochemical Society. *Biological oxidation of aromatic rings : a symposium held at London School of Hygiene and Tropical Medicine on 12 November 1949.* (Biochemical Society Symposia No. 5.) Organized and edited by R. T. Williams. 1950. University Press (Cambridge), 8s. [£0.4]

Birch, C. A., editor. *Emergencies in medical practice.* 2nd ed. 1950. Livingstone (Edinburgh), £1 7s. 6d. [£1.375]

Blackie, W. K. *Child health in warm climates.* 1950. Longmans Green (London), 7s. 6d. [£0.375]

Böhmig, R. *Form- und Wachstumsgesetze drüsenbildender Karzinome.* 1950. Thieme (Stuttgart), 14 Mk.

Boix Barrios, J. *Las cuatro vacunaciones del niño.* (Colección Española de Monografías Médicas.) 1950. Ediciones BYP (Barcelona), 20 ptas

Bonnin, J. G. *Injuries to the ankle.* 1950. Heinemann (London), £3 3s. [£3.15]

Boome, E. J., Baines, H. M. S. S. & Harries, D. G. *Abnormal speech.* 2nd ed. 1950. Methuen (London), 9s. 6d. [£0.475]

Boulin, R. *Le diabète sucré.* 2nd ed. 1950. L'Expansion Scientifique Française (Paris)

Bowes, K., editor. *Modern trends in obstetrics and gynaecology.* 1950. Butterworth (London), £3

British Empire Cancer Campaign. Twenty-seventh annual report, covering the year 1949. 1950. British Empire Cancer Campaign (London)

British Medical Association. *General practice and the training of the general practitioner. The report of a committee of the Association.* 1950. British Medical Association (London), 7s. 6d. [£0.375]

British Medical Association. *The medical practitioners' handbook.* 1950. British Medical Association (London), 5s. [£0.25]

British Medical Journal. *List of journals and abbreviations from the world list of scientific periodicals.* 1950. British Medical Association (London), 10s. 6d. [£0.525]

British Rheumatic Association. *The scourge of rheumatism : report of a conference held by the British Rheumatic Association, London, September, 1949.* 1950. Heinemann (London), 5s. [£0.25]

Brompton Hospital. *Brompton Hospital reports. A collection of papers recently published from the Hospital. Volume XVIII, 1949.* [1950]. Research Department of the Brompton Hospital (London), 12s. 6d. [£0.625]

Burn, J. H., Finney, D. J. & Goodwin, L. G. *Biological standardization.* 2nd ed. 1950. Geoffrey Cumberlege (London), £1 15s. [£1.75]

Carling, E. R. & Ross, J. P., editors. *British surgical practice.* (Vol. 8. Spleen to Yaws.) 1950. Butterworth (London), £3

Charnley, J. *The closed treatment of common fractures.* 1950. Livingstone (Edinburgh), £1 15s. [£1.75]

Chaussinand, R. *La lèpre.* 1950. L'Expansion Scientifique Française (Paris)

Chief Medical Officer of the Ministry of Education. *The health of the school child. Report of the Chief Medical Officer of the Ministry of Education for the years 1946 and 1947.* 1949. His Majesty's Stationery Office (London), 3s. [£0.15]

Clavero del Campo, G. & Pérez Gallardo, F. *Inmunización contra el tifus exantemático con vacuna viva, Cepa E.* 1949. Dirección General de Sanidad (Madrid)

Clay, H. H. *The sanitary inspector's handbook. A manual for sanitary inspectors and other public health officers.* 7th ed. 1950. Lewis (London), £1 5s. [£1.25]

Colebrook, L. *A new approach to the treatment of burns and scalds.* 1950. Fine Technical Publications (London), 12s. 6d. [£0.625]

Colombi, C., editor. *Atti della Società Italiana di Cardiologia. XI Congreso, tenuto a Stresa nei giorni 28 e 29 Maggio 1949.* [1950]. Società Tipografica Modenese (Modena)

Congreso Peruano de Química. *Actas y trabajos del Tercer Congreso Peruano de Química, 17 al 23 de Octubre de 1949.* [1950]. Congreso Peruano de Química (Lima)

Cooper, J. W. & Gunn, C. *Tutorial pharmacy.* 4th ed. 1950. Pitman (London), 18s. [£0.9]

Cowan, H. K. *The health services in the County of Essex.* 2nd ed. [no date]. Published by authority of the Essex County Health Committee by Burrow (London)

Dacie, J. V. *Practical haematology.* 1950. Churchill (London), 10s. 6d. [£0.525]

Darlington, C. D. & Mather, K. *Genes, plants and people : essays on genetics.* 1950. Allen & Unwin (London), 16s. [£0.8]

Davidson, J. N. *The biochemistry of the nucleic acids.* 1950. Methuen (London), 7s. 6d. [£0.375]

Del Cañizo y García, A. & Del Cañizo Suárez, J. *La mesoaortitis luética.* (Colección Española de Monografías Médicas.) 1950. Ediciones BYP (Barcelona), 20 ptas

Department of Health for Scotland. *Poliomyelitis : a survey of the outbreak in Scotland in 1947.* 1950. His Majesty's Stationery Office (Edinburgh), 1s. 6d. [£0.075]

Department of Health for Scotland. *Report of the Department of Health for Scotland and of the Scottish Health Services Council, 1949.* (Cmd. 7921.) 1950. His Majesty's Stationery Office (Edinburgh), 3s. [£0.15]

Dible, J. H. *Dible and Davie's pathology : an introduction to medicine and surgery.* 3rd ed. 1950. Churchill (London), £2 14s. [£2.7]

Dickinson, C. J. *Electrophysiological technique.* 1950. Electronic Engineering (London), 12s. 6d. [£0.625]

Duke-Elder, S. & Goldsmith, A. J. B. *Recent advances in ophthalmology.* 4th ed. 1951. Churchill (London), £1 8s. [£1.4]

Fairhall, T. T. *Industrial toxicology.* 1949. Williams & Wilkins (Baltimore); Baillière (London), £2 6s. 6d. [£2.325]

Family Welfare Association. *Guide to the social services. A year book of information respecting the statutory and voluntary means of assistance.* 43rd ed. 1950. Staples Press for Family Welfare Association (London), 5s. [£0.25]

Fattorusso, V. & Ritter, O. *Atlas d'électrocardiographie à l'usage du médecin practicien et de l'étudiant.* 2nd ed. 1950. Masson (Paris), 2200 fr.

Ferreira-Marques, J. *Contribution à l'étude de l'étiologie, de la pathogénie et de la thérapeutique des maladies prurigineuses. (Acta Dermato-Venereologica,* Vol. XXVIII. Supplementum XIX.) 1948. Mercators Tryckeri (Helsingfors)

Findlay, J. P. *Facial paralysis, being a treatise on a clinical classification of paralysis of the facial nerve.* 1950. Published by the author and distributed by Angus & Robertson (Sydney), 17s. 6d. [£0.875]

Food and Agriculture Organization of the United Nations. *Report of the Nutrition Committee for South and East Asia : second meeting, Rangoon, Burma. 30 January–4 February 1950.* 1950. Food and Agriculture Organization of the United Nations (Washington)

Forbes, J. & Mann, W. N. *Clinical examination of patients, with notes on laboratory diagnosis.* 1950. Arnold (London), 18s. [£0.9]

Frazer, W. M. *A history of English public health, 1834–1939.* 1950. Baillière (London), £1 15s. [£1.75]

Freeman, J. *Hay-fever : a key to the allergic disorders.* 1950. Heinemann (London), £2 2s. [£2.1]

Gask, G. *Essays in the history of medicine.* 1950. Butterworth (London) £1 10s. [£1.5]

Gelfand, M. *Schistosomiasis in South Central Africa : a clinico-pathological study.* 1950. Post-Graduate Press & Juta (Cape Town & Johannesburg), £1 5s. [£1.25]

Gloyne, S. R. *John Hunter.* 1950. Livingstone (Edinburgh), 15s. [£0.75]

Green, D. E. & Knox, W. E., editors. *Research in medical science.* 1950. Macmillan (London), £2 8s. [£2.4]

Greulich, W. W. & Pyle, S. I. *Radiographic atlas of skeletal development of the hand and wrist. Based on the Brush Foundation study of human growth and development, initiated by T. Wingate Todd.* 1950. Stanford University Press (Stanford, California); Geoffrey Cumberlege (London), £4

Hallmann, L. *Bakteriologie und Serologie. Ausgewählte Untersuchungsmethoden für das bakteriologische und serologische Laboratorium.* 1950. Thieme (Stuttgart), 29.70 Mk.

Hammond, J., Browne, F. J. & Wolstenholme, G. E. W., editors. *Toxaemias of pregnancy, human and veterinary.* (A Ciba Foundation Symposium.) 1950. Churchill (London), £1 1s. [£1.05]

Hazard, R. *Précis de thérapeutique et de pharmacologie.* 9th ed. 1950. Masson (Paris), 3100 fr.

Henderson, T. *Principles of ophthalmology.* 1950. Heinemann (London), £1

Henry, A. K. *The hinge graft, or ginglymus implant.* 1950. Livingstone (Edinburgh), 15s. [£0.75]

Hetreed, V. *The control of tuberculosis in a British colony.* 1950. National Association for the Prevention of Tuberculosis (London), 7s. 6d. [£0.375]

Hörstadius, S. *The neural crest : its properties and derivatives in the light of experimental research.* 1950. Geoffrey Cumberlege (London), 15s. [£0.75]

Hofmeier, K. *Die Therapie der übertragbaren Kinderlähmung.* 1949. Thieme (Stuttgart), 7.50 Mk.

Home Office. *Atomic warfare.* (Civil Defence, Manual of Basic Training, Volume II. Pamphlet No. 6.) 1950. His Majesty's Stationery Office (London), 2s. [£0.1]

Horder, editor. *The British encyclopaedia of medical practice.* 2nd ed. (Vol. 1. Abdominal Emergencies to Anus Diseases.) 1950. Butterworth (London), £3

Horder, editor. *The British encyclopaedia of medical practice.* 2nd ed. (Vol. 2. Aphasia to Boils and Carbuncles.) 1950. Butterworth (London), £3

Horder, editor. *The British encyclopaedia of medical practice.* 2nd ed. (Vol. 3. Bone Diseases to Cor Pulmonale.) 1950. Butterworth (London), £3

Innsbruck University, Medical Faculty. *Forschungen und Forscher der Tiroler Ärzteschule (1948–1950).* Vol. 2. 1950. The University (Innsbruck)

Institut pour la Recherche Scientifique en Afrique Centrale. *Premier rapport annuel, 1948.* [no date.] Institut pour la Recherche Scientifique en Afrique Centrale (Brussels)

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Films

The Treatment of Infections of the Hand

made at University College Hospital (surgeons, Mr B. B. Milstein and Mr A. G. Riddell), London, 1950; presented by the British Medical Association; sponsored by Glaxo Laboratories Ltd.; produced by Realist Film Unit Ltd.; obtainable from the British Medical Association or from Glaxo Laboratories Ltd.; available in 16 mm. kodachrome sound only, 1,050 feet [320 m.]; 28 minutes

" The film ' The Treatment of Infections of the Hand ' has been produced to demonstrate advances in surgical techniques that have given good results, which have been still further improved by the simultaneous use of penicillin. All the operations are conducted in a simple manner with instruments, equipment and facilities readily available in ordinary practice ".

This paragraph is quoted from the booklet distributed with this film; the booklet is intended to amplify the techniques and treatments shown on the screen. It is necessary for the booklet to be read as well because a number of points are explained there which are not dealt with clearly in the film; for example, the importance of the anatomical site of the infection is one of the authors' main contentions and in the film these sites are described at such a pace that the ordinary student or practitioner would be unlikely to take them in; in the booklet they are very well shown. Also, the film does not mention the frequency or duration of dosage of penicillin or emphasize the fact that early injection of a single dose (300,000 units) of procaine penicillin may heal the infection so that an operation becomes unnecessary; both these points are discussed in the booklet.

The film shows first the principles of conservative treatment of hand infections—rest and chemotherapy—and early incision is deprecated. Local applications of heat are not encouraged because vasodilatation in a hot pulsating finger is at a maximum; also pain is more effectively relieved by rest and anodynes than by fomentations. When abscess formation is certain, but not till then, the authors recommend incision with the following provisos: that a bloodless field is obtained; that nerve block anaesthesia at the finger or wrist is used; that the incision should not be a standard one but adapted to the nature and site of the abscess. There are further observations on the technique and choice of incision.

The rest of the film deals with the five main types of abscess: pulp, apical, paronychia, carbuncle, and web. An operation on each type is shown and the dressing and healing stages described. To finish, the main points are recapitulated and to the ones discussed above is added another: that natural drainage is adequate. The film recommends that difficult cases and those involving bone or tendon sheaths be sent to surgical units specializing in hand infections.

The booklet contains an appendix on some less common infections of the hand.

Bronchography

made at Midhurst Sanatorium, Sussex, 1949, by Gaumont British Instructional Films Ltd., for the British Council; technical adviser, Dr Foster Carter; directed by Claud Styles-Hudson; obtainable from the British Council; available in 35 mm. and 16 mm. sound, 3,362 feet [1,025 m.] and 1,330 feet [405 m.] respectively; monochrome; 37 minutes

The purpose of this film is to demonstrate the principles and the technique of bronchography. The greater part of the film deals with bronchography by the method of direct tracheal puncture; a detailed account is given of the filling of the right bronchial tree and then the left tree is filled as it would be if bilateral bronchography were done. Indirect methods of bronchography and selective bronchography are also shown and the film ends with a demonstration of bronchography in children.

Throughout the film emphasis is placed on the fact that a sound knowledge of the normal bronchial tree is an essential preliminary to the production and interpretation of bronchograms. The first section to be shown describes the normal bronchial tree and shows how, by careful positioning of the patient, the best results can be got; specimen bronchograms are described to show how abnormalities in the shape, size, and position of the bronchi aid in the diagnosis of diseases of the lung and adjacent structures.

Direct tracheal puncture is recommended as the most generally useful method of bronchography unless the patient has copious, heavily-infected sputum; an indirect method should then be used. For very small children, endotracheal intubation under general anaesthesia is chosen as likely to give the best results.

I.C.I. Film Catalogue

London: Imperial Chemical Industries Limited. [1950] Paper covers; loose-leaf sections. Medical films, 11 pages. 22 × 16 cm. Free on application

Twenty-four 16 mm. medical films, some in colour, some in black-and-white, are listed in the new film catalogue issued by Imperial Chemical Industries Limited. Of these, the first eleven form " The technique of anaesthesia series ", made in collaboration with the Westminster Hospital Medical School, and the next two (collaborators, Guy's Hospital Medical School) concern dental anaesthesia. The remaining items concern the control of infection in surgical dressings, industrial dermatitis, tongue movements in phonetics, and various physiological and pharmacological subjects. Each entry gives the running-time of the film, the name of the hospital or other body which has collaborated in the production, and a résumé of the contents of the film.

Copies of this loose-leaf catalogue, for which supplements will be issued from time to time, may be obtained from the I.C.I. Film Library, Bolton House, Curzon Street, London, W. 1. The films may be borrowed, free of charge, in Great Britain, but they are not available to scientific film societies or other non-medical audiences.

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